American Machinist

Volume 55 NEW YORK, SEPTEMBER 15, 1921 Number 11

Effect of Heat-Treatment on Steel Castings and Drop Forgings

Results of Tests at Different Stages in Heat-Treatment — Chemical Analyses and Their Results — Interesting and Instructive Information Obtained

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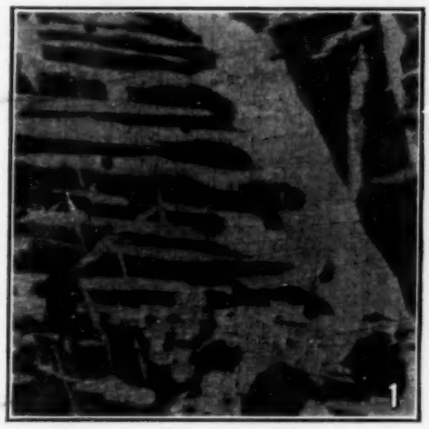
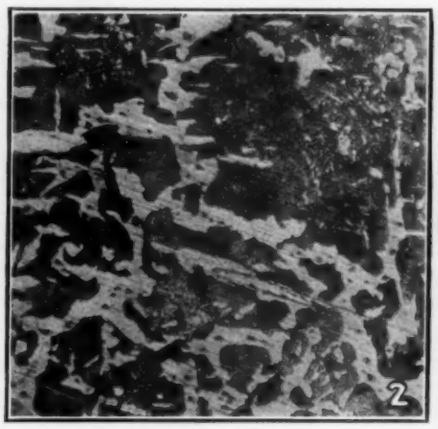
IN the present day of increasing demands of quality and service upon practically every manufactured article, with all manner of searching tests, such as impact, drop, fatigue, abrasion, etc., former standards are daily going by the boards. The man charged with the responsibility of designing and specifying materials often has little practical data upon which to rely, as, all too frequently, published figures are made on the basis of specially selected materials for various tests.

With the purpose of obtaining figures of practical value for use in every-day manufacture, the present series of tests has been made on the comparative heat-treatments of drop forgings and steel castings, as heat-treatment is a necessary operation in the development of steel to withstand the demands of the present day.

The heat-treatment of steel, as is well known, is a process of solution in the solid form of its various constituents, and the redepositing of these ingredients in a more refined state. This solution, as just stated, takes place in the solid state and it is obvious, therefore, that the original size and condition of the constituents of the steel will play a large part in the readiness with which they will respond to this procedure. Fig. 1 shows the structure of a typical steel casting just as the metal solidifies. This form is typical of all crystalline materials after solidification and can be closely compared to the frosting on a window in the winter time. It is the purpose of heat-treatment to break this structure up and to equalize the ingredients throughout the entire mass. The first step in this procedure is annealing. Fig. 2 shows a typical annealed structure of a steel casting. Fig. 3 represents the structure of a forging as it comes from the hammer. The effects of heat treatment on these two materials of approximately the same composition were studied and the results noted and tabulated as follows:

Samples ¾ in. in diameter by 12 in. long were prepared from castings and forgings of nearly the same composition, the material being taken at random from stock-manufactured articles on hand. In each case, the original casting or forging was taken as near as possible the size of the test bar. Thus, the casting was ⅞ in. thick and the forging 1 in. thick. Electric steel castings, annealed, were used and the forgings were unannealed. The compositions were as follows:





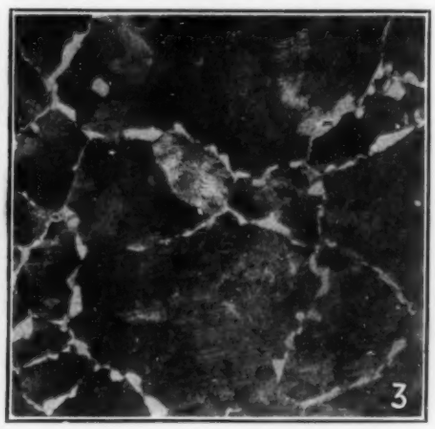
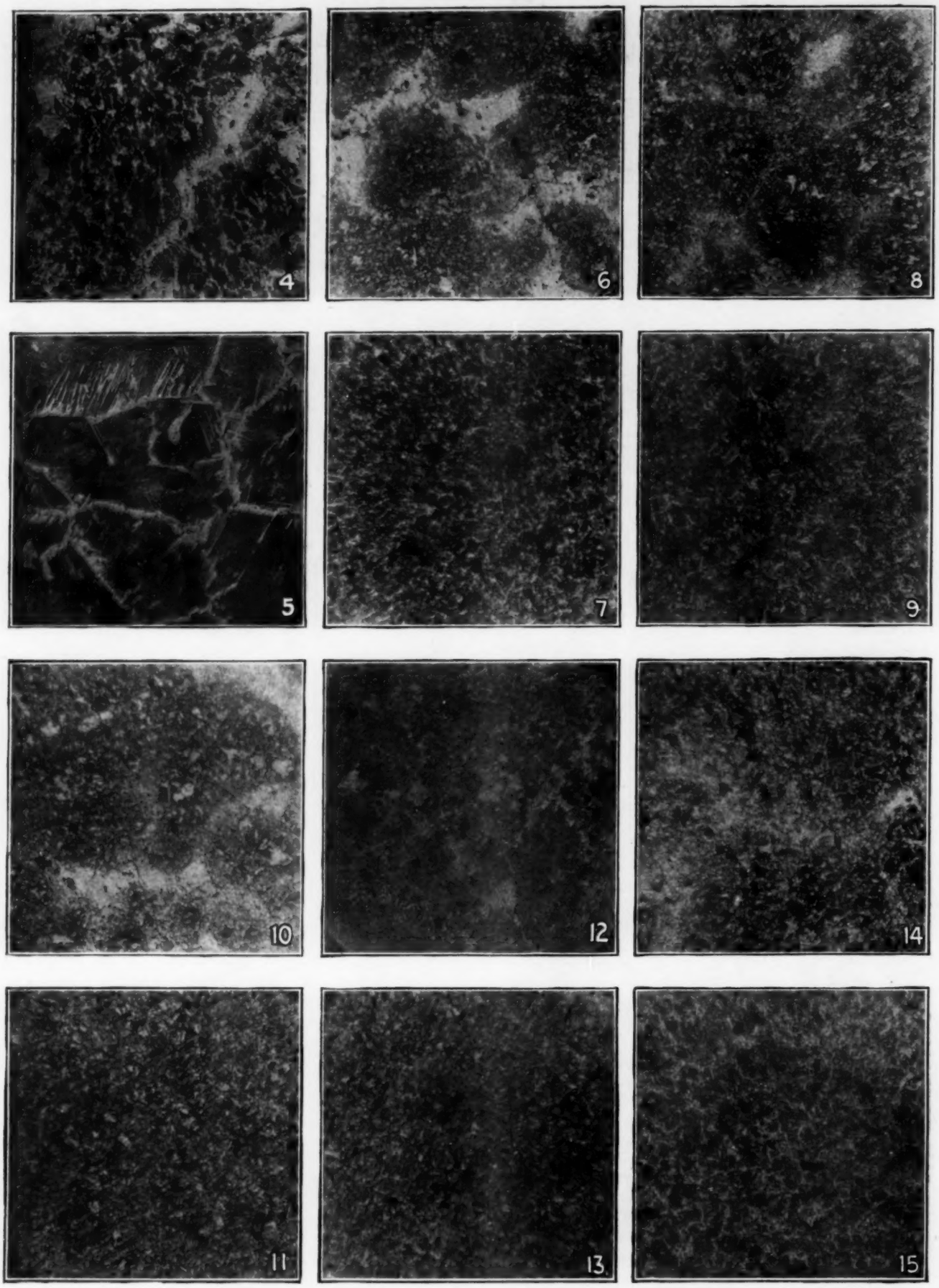


FIG. 1. CROSS-SECTION OF STEEL CASTING (MAGNIFIED 100 DIAMETERS). FIG. 2. CAST-STEEL AFTER ANNEALING. FIG. 3. CROSS-SECTION OF STEEL FORGING

	C.	Mn.	P.	S.
Casting	0.45	0.69	0.044	0.049
Forging	0.377	0 62	0.034	0.043

One casting test bar and one forging test bar were then placed side by side in a standard heat-treating furnace, approximately 2½ ft. square by 3½ ft. deep, thoroughly soaked out at 1,550 deg. F. being accurately controlled as to temperature by a Leeds & Northrup recording potentiometer, the thermo-couple being in contact with the bars. The first pair of bars was left in the furnace 5 min. and then quenched in oil. The next pair of bars was then put in the furnace, left for 10 minutes and quenched. Following these, a pair was put in for 15 min. and so on down the list shown in

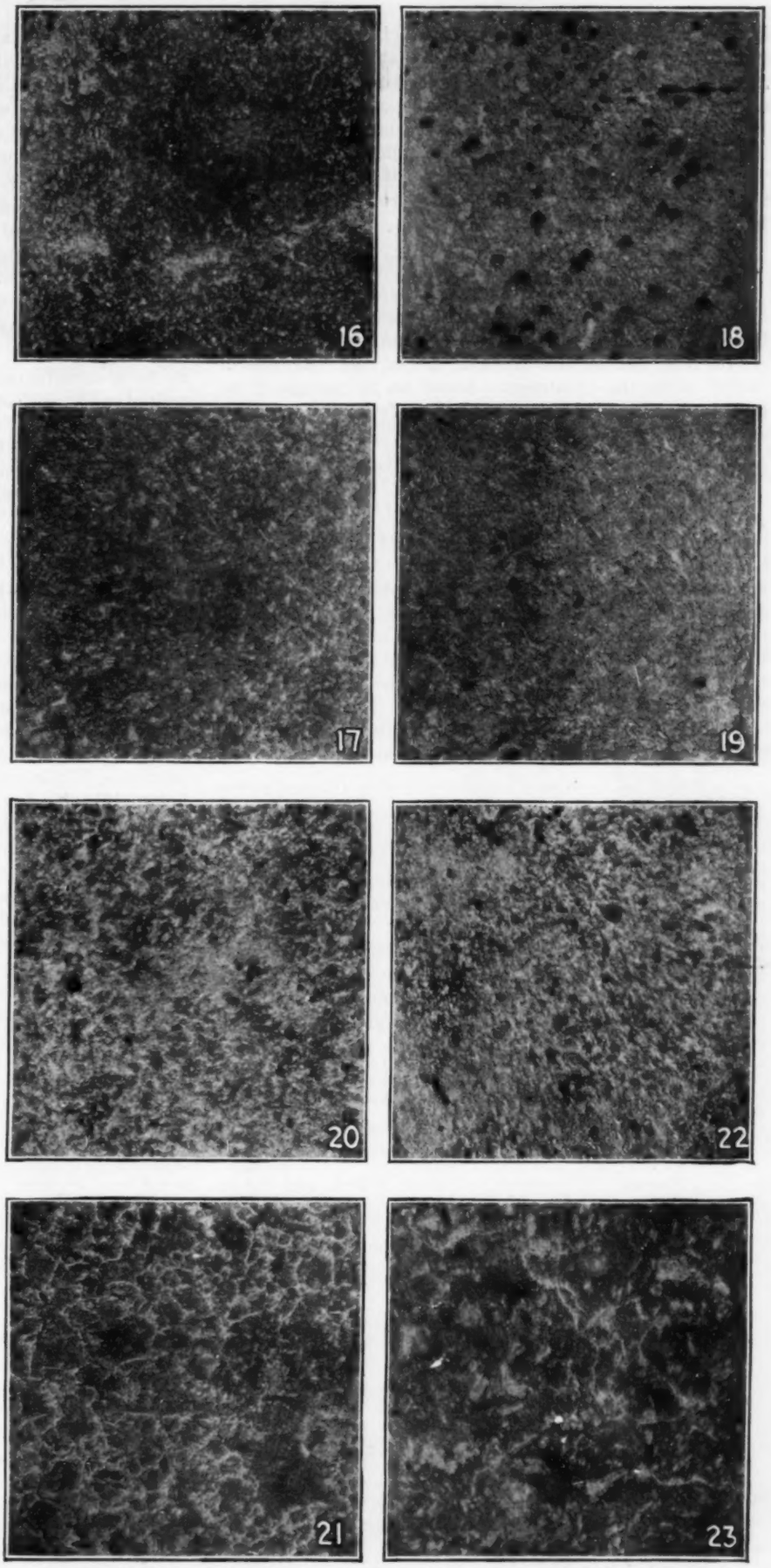


FIGS. 4 TO 15. STRUCTURE OF STEEL CASTINGS AND FORGINGS AT VARIOUS STAGES OF HEAT-TREATMENT

Table 1, up to 5 hr. in the furnace. Specimens from the bars were then examined under a microscope for the results of these treatments.

The bars were cut to standard 0.505-in. tensile test bars and 1 cm. square Charpy impact test bars and tested. A comparison of the photographs, Figs. 4 to 23 inclusive, which were taken of the central portion of each bar, shows more clearly the great difficulty in breaking up the "pine tree" structure formed during solidification of the steel casting, when only heat-treating can be resorted to for this purpose. At the end of 5 min. it is seen that little or no change has occurred in either case. Ten min., however, has proved ample time in which to completely refine the forging structure and to make a slight improvement in the casting. Increasing the time produces little further effect in the forging up to 45 min., while the casting is seen to be progressively refined. From 45 min. on, the structure of the forging becomes increasingly coarsened while the casting becomes more and more uniform in its structure.

Summing up, it is thus seen that the forging is refined in 15 min. to a higher degree than the casting is in 5 hr., or in twenty times the length of time. The practical meaning of this is brought out clearly in the results of the physical tests shown in Table I, and which have been plotted in curves as shown in Figs. 24, 25 and 26. Although the carbon content of the forging is seven points less than that of the casting, it is seen that the physical properties of tensile strength, elastic limit, elongation, reduction in area and impact are higher in nearly every case for the forging. The Brinnel hardness, however, is found to be higher in general for the castings. The very great difference in toughness, as shown by the reduction in area and elongation, is of particular importance. It should be observed that for the forgings, the maximum value in each case is reached after but a short time in the furnace, the later falling off being due to the increasing grain size, as shown in the photographs. This is especially evident in the impact tests. On the other hand, further heating is found to improve the castings to some extent, due, of course, to the



FIGS. 16 TO 23. STRUCTURE OF STEEL CASTINGS AND FORGINGS AT VARIOUS STAGES OF HEAT-TREATMENT

improvement resulting in the structure by equalizing the various constituents. No attempt has been made to draw a smooth line curve through the values obtained for tensile strength of the castings, as it is felt a curve taking in all of the actual values gives a more accurate idea of what may be expected in practical work from material of this kind, as it is subject to so many defects that uniform results from it are almost impossible to obtain.

Tests on Gun Parts

Additional data upon the resistance of steel castings to heat-treatment are found in a paper recently published by Frederico Giolitti,* describing results obtained during the war by Gio Ansaldo & Co., the "Krupps of Italy," with the treatments found to be necessary on gun parts made of cast steel. The following are two such treatments described:

(1) Heat to 1,600 deg. F., cool slowly, consuming 36 hr.
Reheat to 1,520 deg. F., cool slowly, consuming 10 hr.

(2) Heat to 2,010 deg. F., hold at this temperature 14 hr.; water quench.
Reheat to 1,560 deg. F., hold at this temperature 3 hr.; water quench.
Reheat to 1,200 deg. F., hold at this temperature 2 hr.; water quench.

Figures are given to show that short treatments, such as are made for forgings, were entirely inadequate for castings, one such described being "Heat to 1,650 deg. F., hold 45 min., cool slowly." Comparisons made in the work of the Ansaldo company on the relative merits of cast and forged steel of the following compositions:

Carbon 0.21; manganese 0.94; silicon 0.19; phosphorous 0.07; sulphur 0.03; showed as follows:

Casting 77,700 lb. tensile; 53,000 lb. elastic; 27 per cent elongation; 42 per cent reduction in area.
Forging 80,000 lb. tensile; 55,800 lb. elastic; 32 per cent elongation; 60 per cent reduction in area.

The large increase in the reduction in area and elongation are especially important. Charpy impact tests made on the same steels showed a value of 8.13 for the castings and 17.12 for the forging. In other words, Giolitti found that treatments requiring from one to two days, including the heating time, were necessary on steel castings to produce results more or less comparable to those obtained from forgings treated in one to two hours.

*"Steel Castings of High Strength and Toughness," by Frederico Giolitti, *Chemical and Metallurgical Engineering*, vol. 24, p. 113, Jan. 19, 1921.

Points of especial importance to be noticed are: (1) The great superiority of forgings in resistance to shock, as shown by the Charpy impact values; (2) the much greater ductility found in the forging, as indicated by the elongation and reduction in area; (3) the fact that the Brinnel hardness test is not a reliable indication of these properties in the steel.

In order to understand why this large divergence in the properties of products of approximately the same composition should occur, a brief summary of the methods of manufacture involved in each case is necessary.

Inasmuch as both forms of steel start in the steel furnace, the basic procedure is the same in each case up to a certain point, that is, pig iron and scrap are melted and refined by means of one of the several standard methods, such as open hearth, converter, and electric furnaces. Up to the point of pouring the metal from the ladle, therefore, the procedure is, generally speaking, the same, but from thereon wide differences are brought in.

The Small Casting

In the case of the small casting, the metal is run into sand molds where it solidifies to the final form of the desired part. This solidification being more or less rapid, depending on the size and shape of the part to be made, various strains are set up in the cooling due to the variation in shrinkage of portions of different sections in the casting. In some cases, especially in larger castings, these strains are sufficient to crack the casting. While running into and filling the mold, the hot metal, at a temperature of some 3,300 deg. F., cuts away portions of the runner and the mold itself, both being of sand. Most of this sand then becomes trapped in the solidifying metal, as it is unable to escape to the risers on account of the rapid freezing of such a small amount of metal, and also being prevented from escaping by being retained by projections of the contour of the mold. Rapid solidification from this point of view is thus a disadvantage, but, on the other hand, it diminishes segregation as the various elements, *i.e.*, carbon, sulphur, phosphorous, etc., do not have time to travel to other portions of the molten mass, following a lengthy process of progressive solidification. However, with small castings considerable time is

TABLE I

Fig. No.	Material	Treatment	In Furnace	Brinnel	Tensile, Lb. in 2 In.	Elastic, Lb. in 2 In.	Elong., per Cent	Red. Area, per Cent	Remarks	Charpy Impact, Ft.-Lb. in 2 In.
	Casting	Annealed	.....	179	80,000	36,000	5.5	6.6	Straight fracture	36
	Forging	Untreated	.....	174	86,275	42,000	24.5	50.6	¾ cup	135
4	Casting	1,550° F.	5	183	90,000	45,000	10.5	10.4	Straight fracture	58
5	Forging	Oil quench.	min.	187	89,150	45,000	26.0	50.3	¾ cup	52
6	Casting	1,550° F.	10	302	115,400	60,000	0.03	4.3	Straight across	67
7	Forging	Oil quench.	min.	286	116,125	72,500	22.5	53.5	¾ cup	131
8	Casting	1550° F.	15	248	77,250	.....	0.0	4.7	Jagged	80
9	Forging	Oil quench.	min.	269	117,900	55,000	21.5	54.9	¾ cup	138
10	Casting	1550° F.	20	286	81,600	62,000	.....	.....	.....	75
11	Forging	Oil quench.	min.	269	117,550	57,500	18.5	55.1	¾ cup	68
12	Casting	1550° F.	30	286	73,875	45,000	0.05	3.5	Jagged	62
13	Forging	Oil quench.	min.	286	119,675	70,000	19.0	52.5	Full cup	86
14	Casting	1550° F.	45	286	115,350	68,500	.....	.....	Straight fracture	79
15	Forging	Oil quench.	min.	255	112,230	49,320	18.5	54.05	¾ cup	155
16	Casting	1550° F.	1	269	99,250	77,500	0.02	3.14	Irregular	88
17	Forging	Oil quench.	hr.	255	112,275	69,000	18.0	48.6	¾ cup	98
18	Casting	1550° F.	1½	269	56,500	49,000	0.02	4.7	Defective	86
19	Forging	Oil quench.	hr.	255	108,700	70,000	18.5	53.5	¾ cup	104
20	Casting	1550° F.	3	269	83,750	75,000	0.02	3.94	Jagged fracture	95
21	Forging	Oil quench.	hr.	255	110,725	60,000	20.0	54.4	¾ cup	81
22	Casting	1550° F.	5	255	118,350	51,500	.....	.....	Straight fracture	90
23	Forging	Oil quench.	hr.	255	109,150	55,000	18.5	47.2	¾ cup	30

RESULTS OF TESTS AT DIFFERENT STAGES OF HEAT-TREATMENT

necessary to pour a complete heat from the ladle, with the result that segregation occurs in the ladle itself, so that the first and last castings of the same heat will vary in composition to a considerable extent. Occasionally this is reduced by pouring from two ladles simultaneously. During solidification, the steel, as in general of all solidifying materials, assumes the characteristic "pine tree" or dendritic structure illustrated in Fig. 1, which also shows the prevalence of slag particles above referred to.

Necessity of Heat-Treatment

As the steel is now in its final form, no further operation of a mechanical nature can be employed to break up this extremely coarse and brittle structure and, therefore, heat-treatment is the only recouse for refinement and this method must carry the entire burden of fitting the casting for the service it is to be called upon to perform. Steel made for small castings by the electric furnace process is probably the best made at the present time, inasmuch as higher temperatures are obtained, so that a larger degree of impurities are burned out resulting in a more nearly clean and sound steel, and also as the metal is hotter at the time of

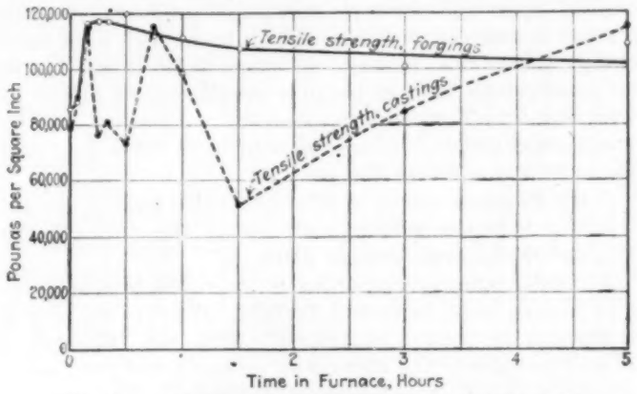


FIG. 24. COMPARISON OF TENSILE STRENGTHS

pouring a somewhat longer length of time is required in solidifying, which allows the entrapped slag and sand a greater opportunity to escape. High temperatures, on the other hand, give rise to larger crystals in solidifying and increase the difficulty in breaking up the structure in the subsequent annealing and heat-treating. Therefore, as electric steel castings are probably better than others, only such castings have been considered in the present examination for physical tests, photographs, etc.

Properties of Steel Ingots

Turning now to the procedure involved with drop forgings and taking up the thread where the metal is in the ladle ready to pour, various differences are found which effect, in a great degree, the properties of the final product. Instead of being poured into small sand molds with the undesirable effects of slag and sand inclusions, gas pockets, etc., as described above, the metal is run into large iron ingot molds where it solidifies comparatively slowly, allowing the slag time to rise to the top of the ingot and leaving the ingot body relatively clean. This is further aided in good steel practice by the use of "hot tops" made of fire clay on the top of the mold, as the "top," being a heat insulator, keeps the upper portion of the steel molten for a longer time and allows the slag greater opportunity to escape and also serves as a reservoir of molten metal to fill the cooling ingot, so as to reduce the tendency to form pipes and shrinkage holes. As the metal is thus poured rapidly into large molds, little difference due to segregation will be found between the first and last ingots, as found in the case of the castings. On the other

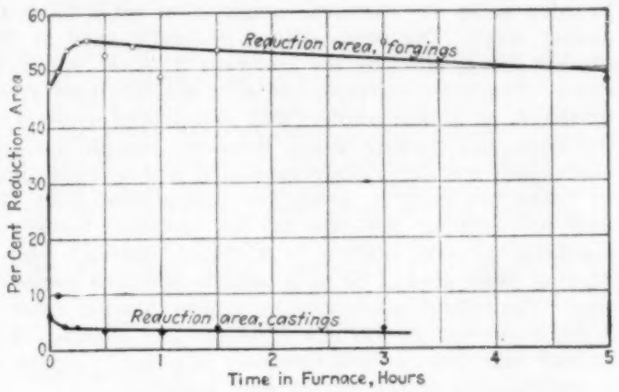


FIG. 25. COMPARISON OF AREA REDUCTION

hand, as the metal cools slowly in the large ingots, segregation is found in the ingot itself and the slow cooling also gives rise to the formation of larger crystals in solidifying than in the case of the small, more rapidly-freezing castings.

When cooled sufficiently, the ingot is removed to the "soaking pit" where it is heated evenly throughout and then rolled out into bars of the desired size and shape. This rolling breaks up, in a large measure, the massive crystal forms of the ingot, which is known as "ingotism." The structure produced by the rolls is one in which the crystals are well broken up and elongated. The bars are then cut into billets, reheated to the forging heat and shaped between dies in the drop hammer. This vigorous working of the metal removes the last traces of ingotism, the result being shown in Fig. 3. The steel is now in a condition which readily responds to the simplest heat-treatment. Sometimes a large grain size may be found from overheating during forging, but as this grain is the result of a secondary crystallization, that is, it has not been formed from the

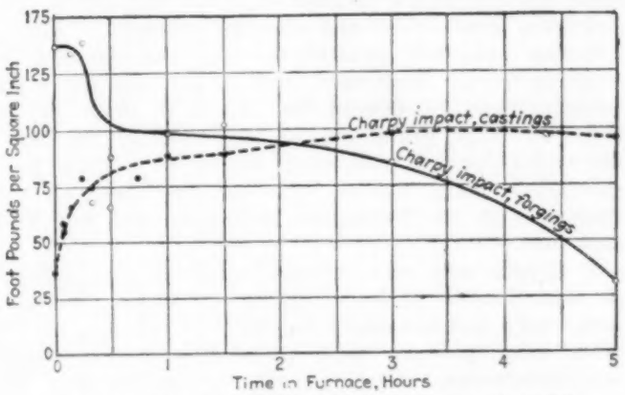


FIG. 26. COMPARISON OF RESULTS OF CHARPY IMPACT TEST

primary solidifying of the metal, it is easily broken up on reheating.

Under the discussion of steel castings, it has been explained that there is a tendency for the inclusion of slag, sand, gases, etc., in the steel while solidifying. As has been mentioned, the use of highly heated electric steel diminishes this difficulty. Another method is by

varying the composition of the steel. This thus places the composition of the steel subject to variation of analysis, arising from the size and shaps of the article, disregarding the strength and serviceable qualities desired. Forgings, on the other hand, are made of steel closely guarded as to its chemical composition on a basis of quality only. The compositions generally used at the present are covered by the standard S. A. E. specifications. Thus, for castings, the only specifications given by the S. A. E. are sulphur and phosphorus under 0.05 per cent; for forging stock, however, the carbon and manganese are also closely regulated and a lower limit of 0.045 per cent is given for phosphorus than the 0.05 per cent in the case of the casting. Generally speaking, a steel casting is a "steel casting," but a forging must always be of a definite specified composition. The following analyses have been taken at random from a number of various forgings and castings and in each case from different makers in order to arrive at a general idea of the run of such material.

Castings

	Carbon	Manganese	Phosphorous	Sulphur	Silicon
Converter steel..	0.12	0.41	0.046	0.092	0.32
Electric steel....	0.43	0.59	0.037	0.075	0.30
Open hearth steel	0.14	0.50	0.059	0.117	0.33

Forgings

Carbon	Manganese	Phosphorous	Sulphur
0.14	0.47	0.026	0.031
0.39	0.36	0.013	0.034
0.193	0.48	0.013	0.036
0.184	0.40	0.010	0.038

As stated, each analysis is from a different manufacturer and, as the sources extend all the way from New England to the Middle West, the figures are fairly representative of national practice. An examination shows sulphur and phosphorus, the two worst enemies of good steel, to be on an average twice as high in castings as in forgings.

One of the largest fields in the use of steel forgings includes the use of alloy steels, heat-treated, which makes possible articles of very light weight and small cross-section. The use of alloys in steel carries with it the necessity of heat-treatment, as it is only through heat-treatment that the greatly increased strength produced by the alloys is realized, thus warranting the additional expense of the alloying material. Alloys, however, generally greatly increase the dangers of cracking during treatment, and as castings are more liable to fracture, due to the strains in them and to the very large grain size of the crystals, the benefits to be derived from alloy steels for casting purposes are more limited than in the case of the forging with its thoroughly broken up and well knit structure.

It is thus seen that castings present a very difficult problem indeed in heat-treating to obtain ductility, uniformity and resistance to shock. Forgings, on the other hand, produce these qualities with very simple heat-treatments. Castings are, of course, also less desirable than drop forgings on account of their well known tendency to contain blow holes and sand pits, and to their variance in size and shape. Castings have the distinct advantage of application to practically all designs, whereas forgings are largely limited to simple shapes.

Freight Rates Bother You?

A man from the coast came in to see us yesterday. He says that the Northwest cannot sell its lumber in the East because the freight rate is too high—the door is closed to them.

A man from the South was in last week. He said the South could not profitably ship its products to the West because the freight rate was too heavy—and they weren't shipping.

The area of the United States is over 3,000,000 square miles and the railroad mileage is something over 250,000 miles. The familiar map with its resources carefully marked thereon remains the same. BUT you will have to think of the distribution of those resources in new terms before very long if the present charges for freight remain in force.

Water borne freight from South America can handle grains, hides and similar competitive products into the United States cheaper than the railroads can haul such things across the country. Western fruit is not found in the Eastern market because people cannot afford to pay for it. Temporarily, that is a blessing to the Southern fruits but in the long run some other item will enter in and equalize the gain.

New England can now afford to raise grains for its own use, for the freight rate boosts the price of the fruit of the central western fields up.

Consider what is happening to your own product; are you finding that increased freight rates are making a difference in your distribution? Are you taking any means to express the opinion of yourself and your associates in this matter?—*Helix* (Greenfield Tap and Die Corporation).

Turning V-Grooves

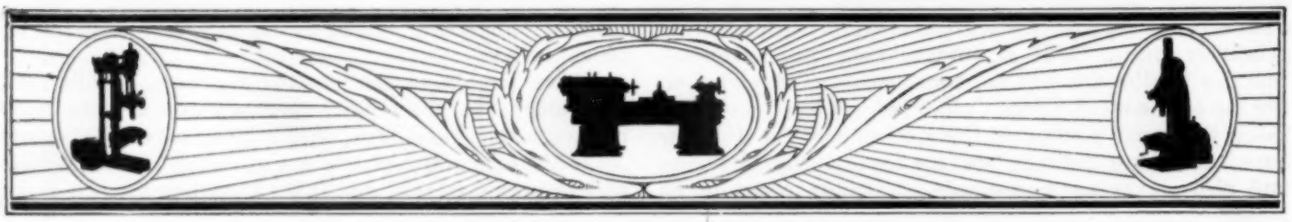
By E. C. Gifford

We had a large number of V-grooved malleable iron fan pulleys to make. Perhaps our experience in machining them may help some reader.

A high-speed tool was forged to form the V-groove and ground with 6-deg. clearance on each side and flat on the top face.

Upon trial, it was found that the cutting edge would not hold up, and the finish obtained on the work was poor. The chips crowded and caused the tool edges to give way.

As an experiment, the tool was hollow ground on top. This gave a keener edge and one which would curl the chips sufficiently to eliminate crowding. The tool life was thus increased many fold and the finish was quite satisfactory in quality.



The Economics of Production

IV. CAUSES OF CHANGES IN DEMAND

By Prof. D. A. McCabe, Ph.D.

IT HAS BEEN pointed out in previous articles that the kind and quantity of production depends upon demand. Producers are always trying to anticipate the demands of the public in their selection of the kind of goods they produce and to keep the volume of their production from exceeding the quantity that can be sold at a profitable price.

With a stationary demand it might not be too difficult to work out what would be the right quantity of each kind of goods to produce—that is, the right quantity to meet the demand at a reasonably profitable price. But with a changing demand, we have changes in the quantity that bring the reasonably profitable price, and, naturally enough, changes in the quantity produced. Changes in the volume of production may mean so much in the way of changes in profits, in wages, in unemployment, and even in the conditions of human living, that we are all anxious to learn as much as we can of the causes of the changes in demand that bring about these frequent fluctuations in the volume of production.

> The fundamental factor affecting the volume of current earnings is the volume of production. We are speaking here of the earnings of all engaged in business. Employers, wage-earners, middlemen, transportation men, farmers, and all others who derive income of any kind from current operations make up the public in this sense. And the volume of earnings of this public as a whole increases when the volume of production increases and decreases when the volume of production falls. If we don't produce and sell we cannot demand; we have too little to demand with. And when we stop demanding from the others they in turn have to cut down their demands, because their production is reduced.

In speaking of a change in demand we may be speaking of a change in the demand for a particular commodity, as for example, automobiles, or of a change in the total volume of demand for commodities, such as we experienced in 1920. Changes in the demand for particular goods are occurring all the time, usually because of some development that affects particularly the commodity in question as apart from commodities generally. Changes in fashion and the introduction of new articles, as for example, a safety razor, that suits the public better than the old one, are continually lowering the demand for one commodity and increasing the demand for another.

Changes of this sort affect very seriously the profits of producers and the employment of men in particular plants. They have not, however, the general consequences that follow from large changes in the demand for commodities in the aggregate. It is to changes of this latter class that we shall devote our attention.

General increases or decreases in the demand for goods proceed as a rule from changes in the amount of money the public is earning. When the public is making more money it ordinarily spends more. It may save more but it also spends more. When it is earning less it, of necessity, reduces its offers for goods. Some people in such times purchase from their savings; nevertheless the total volume of expenditures is reduced. Saving helps somewhat to even up the general demand for goods between the period of good earnings and the period of reduced earnings, but it has not yet been carried far enough to prevent a decline in the general demand for goods when current earnings fall off.

It is true that the public may reduce its purchases when there has been no reduction in its earnings. It may feel that prices for some goods are unreasonably high and resort to a temporary "boycott" or "buyers' strike" in order to force them down. The danger in this is that the reduced demand which begins as a matter of choice may develop into a reduction in demand which is forced by reduced earning power. The reasons for this will appear below. For the moment it is enough to repeat that for the most part the demand for goods in the aggregate rises and falls with the volume of earnings.

The fundamental factor affecting the volume of current earnings is the volume of production. We are speaking here of the earnings of all engaged in business. Employers, wage-earners, middlemen, transportation men, farmers, and all others who derive income of any kind from current operations make up the public in this sense. And the volume of earnings of this public as a whole increases when the volume of production increases and decreases when the volume of production falls. The aggregate money earnings of the public may be increased or decreased independently of the volume of production through an increase or decrease in the amount of money in the country. The increase in money was an important factor from 1916 to 1919, for example. But the most important single factor affecting the total earnings of the public in any one season, and the one subject to the sharpest changes, is the volume of production.

It may seem confusing to say that production depends upon anticipated demand and then to say that demand depends upon production. But it is true. It is one of the perplexing facts of the complicated industrial system under which we work and live. It is due to the fact that we produce for others and demand from others. If each family produced only for its own consumption and therefore consumed only what it produced for itself, it would be quite clear that its consumption would be limited by its own production. Under our present system it is still true that we are both producers and consumers, but our production is for others and our capacity to demand goods from others for *our* consumption depends upon our producing goods that they will buy from us. If we don't produce and sell we cannot demand; we have too little to demand with. And when we stop demanding from the others they in turn have to cut down *their* demands because *their* production is reduced.

Let us assume that the producers in a given line, say automobiles, have to cut down their production. It may be because the manufacturers cannot get the necessary credit. It may be because there has been a big falling off in the foreign demand. It may be because there have been big crop failures and the farmers and all the business people in agricultural sections whose business prosperity depends upon the prosperity of the farmers have to cut down their demands and have begun by cutting down their demand for automobiles. It is clear that all in the automobile industry and accessory industries and all the automobile dealers will have less earnings. They will have to cut down their demands for the goods of others, for tires, for supplies, for machine tools.

All those producers who have been producing to meet the demand of those consumers engaged in the automobile business will now be faced with a decline in the demand for *their* goods. If they meet it by reducing *their* production, employment and earnings will be still further reduced and the demand for goods in general will have to suffer another reduction. And so it goes, each decline in production causing a reduction in demand and this in turn causing another decline in production until a halt is called somewhere by demanders or producers and the wheel is started spinning in the other direction.

A look at the more cheerful side shows the same connection between demand and production. When producers enlarge their operations the prospects are bright for an increase in the demand for goods in general. The increase in employment in those industries and the increase in the volume of business handled by the distributors of those lines adds to the buying capacity of those groups. They accordingly increase their demand for goods and this stimulates other producers to increase *their* production, with the result that still more people are more actively engaged and earning more money with which to increase still further the demand for goods in general. From necessities the increasing demand advances to luxuries and from finished goods to the machinery, tools, supplies and raw materials necessary for their production. It sweeps on from shoes to touring cars and from clothes to looms, and every upward move in production leads to a better market for products until something happens to check the upward swing.

This check may be a sudden falling off in demand, or it may be an enforced stoppage of production. Whether it be the one or the other that drops first, if one goes down the other goes down with it. Demand cannot long hold its place after production is reduced, nor will production maintain its pace unslackened after demand has dropped back.

The adjustment of production to a general decline in demand is a difficult and frequently a tardy process. It involves losses to many and usually it does not take place without much disagreement and much trying to avoid the inevitable. It will be the subject of the next article.

A Thought Along the Right Line

The caption furnishes sufficient comment on the following letter sent out to the trade by J. E. Kelley, general sales manager of the Simonds Manufacturing Co. of Fitchburg, Mass.:

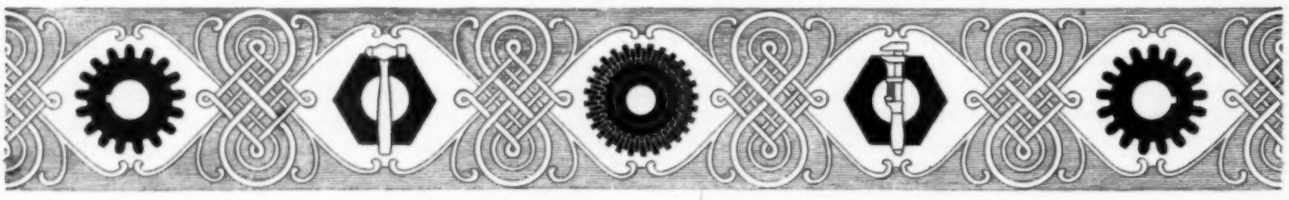
"For the last twelve months we have been liquidating. We have all been wearing out our old shoes, our old clothes, patching up our tools, reducing our stocks and getting along without purchasing, excepting just the various essentials absolutely necessary to carry along our very much depleted business. We have cut out extravagance in so far as purchasing materials is concerned, but statistics prove that we have added another far greater piece of extravagance to our list than any heretofore indulged in, and that is the extravagance of wasted time. We have reduced our energies more in proportion than we have reduced our expenses, and most of us find ourselves today wastefully waiting and watching for the gold nuggets to come to us. In other words, we have stopped hustling.

"It was the writer's personal privilege to visit Japan shortly after the Russian-Japanese War, going as far north as the island of Hokkaido and as far south as Nagasaki, and at that time all Japan had been advised by circular letter from the Emperor to curtail all expenditures possible; to get along with as little as possible. They were certainly doing that. People were without shoes in the coldest part of winter and were using ordinary sacking to wrap their feet in. They were without knives and forks to eat with, without chairs to sit on and with hardly any of the ordinary comforts of life. They were getting along without much of any expense, but they were not producing. They were undergoing hardships to themselves and were not profiting by it. They had allowed the idea of curtailment and penury to supplant action and work.

"As I view the last twelve months here, I can see a considerable comparison to that of Japan after the Russian-Japanese War. We can get along on very little if we force ourselves to do so, but what do we gain by it? The world needs products and all kinds of products. In our opinion the best thing for all of us to do is to take our losses and start in to work and build them up again; mark the prices of our goods down and cut the price of labor down, and insist on more hours work from every employee and more active work from all salaried employees. Start booming activity and by the reduction of prices enable those working for a lower wage to procure as much, or nearly as much, as during the war period.

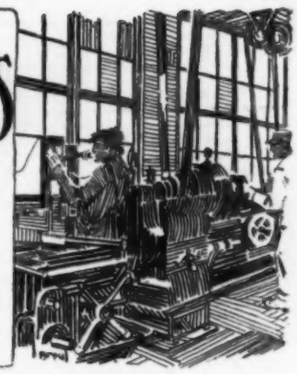
"We have reduced the price of saws, in fact of all the material which we manufacture, to a point which we believe is less than the present cost of manufacture; and we hope by doing this to so stimulate business that the increased demand will let us operate at a profit.

"We ask you if you won't take the idea contained in this letter and send out to your trade something along a similar line creating a chain of thought that will help toward getting busy, for that is the one thing that will change present conditions."



MODERN PRODUCTION METHODS

By
W P. Basset
of
Miller, Franklin, Basset & Co



XXI. Graphic Methods of Control

When To Use Graphic Charts and When Not To—Proper Use of Charts Saves Time—Master Charts

GRAPHIC charts sometimes affect an executive as does golf, in that, after first scorning the fad, he is in danger of taking it up so enthusiastically that he finds but little time left for his business.

Charts may or may not be inexpensive, yet valuable aids to managing. It is undoubtedly true that a picture is more effective than a thousand words of description—to some men. Business facts are sometimes more quickly grasped in the form of graphs than as columns of figures. But that is not always true; I have seen most complex, hard to read graphs drawn up to present simple and sometimes unimportant facts.

For example, one of my clients determined to have his expense analyses drawn up graphically. Opposite each item he drew a horizontal line whose length indicated the value of the normal figure. Under this a red line was drawn to show the actual amount of that item for the month. At a glance the relative length of the lines showed whether the actual expenses were greater or less than the normal, and approximately how much. But the expense analysis which has been reproduced in this series of articles gives the normal and actual expense in the exact figures. Since they are in parallel columns and require no further analysis to tell their story they are much easier to read than a graph and more accurate. To graph them takes nearly half the time of a clerk.

This is a typical example of the kind of report *not* to chart. At the other extreme is the graphic control chart used in planning production which is shown in Fig. 33, Article VII. Here the problem was to show by hours the progress of a large number of different parts from machine to machine. These figures have to be changed from day to day to reflect the actual performance of the factory. Even though it might be possible to draw up a form on which the information could be shown, the information in other than graphic form would be unintelligible and the clerical work would be so tremendous that the data would be out of date before it was compiled; and the mere physical bulk of the control mechanism would be enormous. A single clerk, however, can keep the charts up to the minute, and the future plans for, and the present condition of production are easily grasped. For such a purpose the graphical chart is justified. When figures are more easily read than curves, figures should be used. For the borderline cases, careful consideration should precede the decision to use graphs. Ordinarily, I believe that statistics are more easily grasped as figures than as graphs. But graphs are undeniably spectacular and poor ones often find their way into the routine of a business because of a child-like love of pretty figures which most of us have.

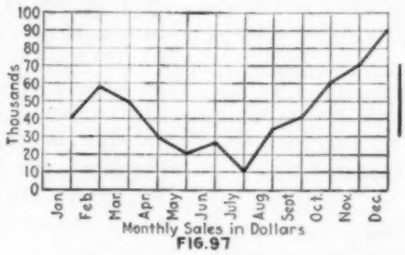


FIG. 97

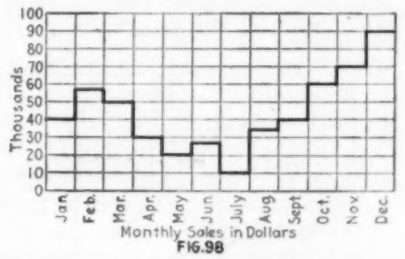


FIG. 98

FIG. 97. MISLEADING SALES CHART. FIG. 98. A BETTER CHART FOR MONTHLY SALES

There is a danger inherent in certain types of graphic curves that must be guarded against. Take the chart shown in Fig. 97. To my mind, this information might much better be shown in figures, or in the graphical form shown in Fig. 98. The reason is this: The points which determine the curve are located on the last day of the month and are the total sales for the month. But I find that most men unconsciously fall into the habit of considering that they can determine the sales for intermediate periods from the curve. For instance, they will assume that the sales for the first half of September are $50,000 because the curve on Sept. 15 is at $50,000. Actually on such a chart the month does not cover the vertical space, but simply the vertical line. How ridiculous such a proceeding is, is shown when one tries to interpolate when sales are falling off, for in March it would appear that more goods were sold up to the 15th than for the full month. The temptation to make this error does not exist if the information is presented as in Fig. 98.

Mathematical curves are, of course, drawn so that any intermediate figures may be determined. Most business curves are not mathematical; they are purely statistical.

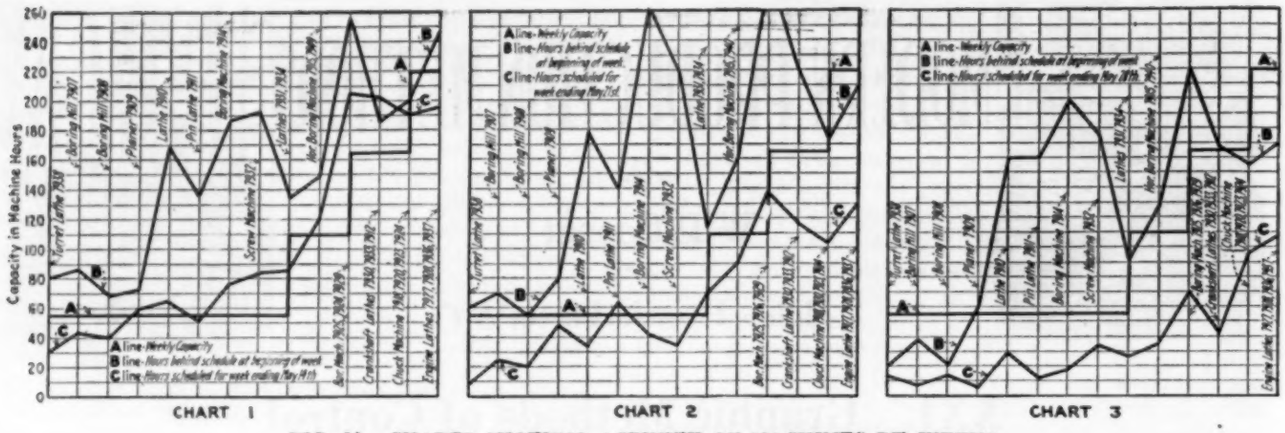

Capacity in Machine Hours
A line-Weekly Capacity
B line-Hours behind schedule at beginning of week
C line-Hours scheduled for week ending May 7th
A line-Weekly Capacity
B line-Hours behind schedule at beginning of week
C line-Hours scheduled for week ending May 14th
A line-Weekly Capacity
B line-Hours behind schedule at beginning of week
C line-Hours scheduled for week ending May 21st
CHART 1
CHART 2
CHART 3

FIG. 99. CHARTS SHOWING ACTIVITY OF MACHINES BY WEEKS

To my mind, the most valuable charts are those which enable the executive to forecast conditions. The three charts shown in Fig. 99 are for consecutive weeks. They show the exact activity of the machines in a department, and give information on which to determine whether or not additional work for those machines is needed or can be taken. In that way, they serve to guide the sales department.

By showing the amount of work ahead, they guide the labor department by making known the need for additional men, or the possibility of dropping a few, weeks

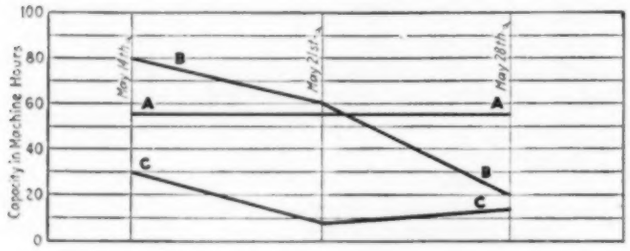


FIG. 100. CHART SHOWING ACTIVITY IN HOURS AHEAD OR BEHIND WEEKLY SCHEDULE

ahead. One man keeps these charts up to date in about three hours a week.

They show the weak spots in unmistakable form, for it should be borne in mind that owing to the balancing of production by the planning department, any machines behind schedule mean that certain parts will be lacking when the assembly floor is reached and consequently some parts will accumulate on the assembly floor waiting for others.

They also show the amount of work scheduled for the shop each week, in advance.

These particular charts show very clearly the decrease in work going into the plant due to the lack of new orders. These conditions were predicted from the charts and on the week following that for which Chart No. 3 was drawn, the working force was reduced and also the week was reduced from 55 to 44 hours.

It may be interesting to follow these charts in a little more detail; for example, Chart No. 1 shows through line "B" that the entire department is behind schedule anywhere from one to three weeks. Line "C" shows a healthy and well-balanced amount of work being sent into the shop.

Chart No. 2 shows a marked increase in some instances of work behind the schedule, notably machine No. 7914. This chart also shows a marked decrease in the amount of work going into the shop.

Chart No. 3 shows a decrease in work behind schedule, due in part to the small amount of new work scheduled for that week and also because machines No. 7914, 7925, 7926 and 7927 were worked overtime in an endeavor to balance production and allow the assembly floor to clean up its work, which resulted in cutting down the working hours of the factory.

These charts may be confusing to some, because the time element does not enter into any single chart, each chart being for a single week. Commonly, charts show time from left to right. Therefore, these charts might well be drawn a chart to a machine as in Fig. 100, plotting the activity in hours vertically and the time in weeks horizontally. The information would be shown as well—perhaps to some minds, better. I mention this alternative simply to show that usually information can be presented in graphs in several ways and it is up to the executive to decide which way he prefers.

A common fault is to draw too many curves on a single chart with the resultant crisscrossing of lines which makes the chart hard to read. If the curves are not related, draw but a single curve to a chart. If they are related and it is desired to see how one set of figures is affected by the movement of another set, it is best to reduce the two sets to a ratio and plot the ratio.

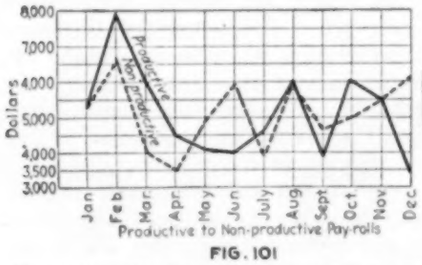


FIG. 101

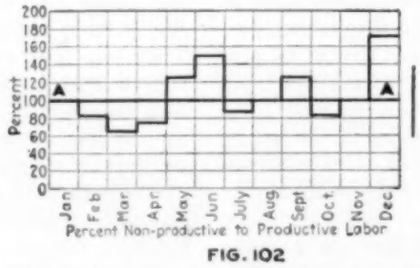


FIG. 102

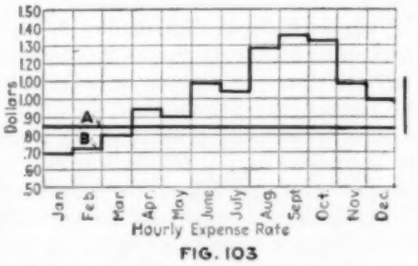


FIG. 103

FIG. 101. CHART OF PRODUCTIVE AND NON-PRODUCTIVE PAY ROLLS. FIG. 102. CHART SHOWING RATIO BETWEEN PAY ROLLS. FIG. 103. CHART OF HOURLY EXPENSE RATE

Take for an example the two charts, Figs. 101 and 102: It is often desirable to watch the amount of non-productive labor, lest it run unduly high for the amount of productive labor. Now, the productive and non-productive payrolls can be plotted month by month, as in Fig. 101, but the chart is hard to read because the lines crisscross. Then it requires what amounts to a mental calculation to determine whether at any time the productive payroll is rising too rapidly considering the amount of the non-productive. The information is given at a glance in Fig. 102 where the dollars and cents of each payroll are reduced to a single curve which is the ratio of the non-productive to the productive expressed in per cent.

Suppose that past experience showed that for this plant a normal ratio based on efficient manufacturing demanded that for each dollar of productive labor, a dollar of non-productive labor was required. The horizontal line *a-a* at the 100 per cent point shows this normal. Then monthly, as shown on this chart, or even weekly or daily, the actual ratio is plotted. So long as the actual ratio approximates the normal, conditions are satisfactory. But if the ratio rises far above 100 per cent, as for May and June, steps will be taken to lay off some of the non-producers.

This condition may be due to the plant activity falling off and failure of the foremen to reduce the non-productive force proportionately, or it may be caused by undue expansion of the non-productive force which nearly always occurs when supervision is lax. In the small plant, it may be sufficient to make one chart cover the entire factory; in larger plants it may be well to make such a chart for each department a main division.

Similar in appearance is the chart shown in Fig. 103, which shows the actual hourly overhead rate of a department as compared with the normal. The data from which the chart is drawn comes from the expense analysis for the department. The line *a-a* is the standard hourly rate—85c.—based on normal activity of the department. During the first three months of the year shown on the chart, the department was operating somewhat above normal activity and the hourly rate was therefore safely below normal. In April, new orders began to fall off, so steps were taken to reduce overhead with the resulting tendency back toward a normal rate as shown for May. Business, however, got steadily slacker, and the curve, by rising promptly, showed the tendency. Had radical cuts in overhead not been made, the curve would very likely have soared off the chart. As it was, it rose considerably until October, when, with new business coming in, the factory increased its activity and the hourly rate approached normal.

Such curves as the last two I have described, both of which show ratios and their tendencies, are to my mind among the most valuable an executive can get.

It is not uncommon to have a chart showing the state of collections from month to month. However, the mere rise and fall of the collection line does not give much of an indication as to how well customers are paying unless it is related to the amount of sales, and inasmuch as few businesses sell for cash, a chart on which there was a line for sales and another line for collections would not mean much. Therefore, it is best to draw a curve representing the ratio between collections and sales. If a business sells on thirty days' time, the business is obviously collecting this month for the sales made last month. Therefore a curve for such a business would consist of a ratio expressed in a per cent of this month's collections to last month's sales. If the terms of sale were sixty days, the ratio would be between this month's collections and month before last's sales. It is not necessary to reproduce a chart of this sort, for it can well be drawn in the same way as that shown in Fig. 103. Then, if the line rose from month to month, it would show that customers were taking more than the proper time which would indicate either laxity on the part of the collection department or a disturbing condition in the trade. In either event, it would indicate to the executive that some steps were necessary and it would not be difficult for him to decide which steps to take. It might even be well to chart a similar curve showing the ratio between the collections that were coming in on the discount date and those which were allowed to run to the full time.

There is one other type of chart different from any that have been discussed which I generally refer to as a master chart. The purpose of a chart of this kind is to provide a means by which the executive can make sure that he is keeping his working capital in balance. The working capital of a business consists of cash, raw materials, goods in process, finished goods and accounts receivable. The rate of capital turnover, and hence to a degree, the profits of the business, depend upon keeping the working capital properly balanced between these various forms. It may seem to many executives that it is unlikely that a business will have more cash on hand than it needs, but that is a condition which is not at all impossible. It is granted, however, that weaknesses in the manipulation of working capital are more apt to come through having too large a goods-in-process account, through over-buying raw materials when the sales department brings in large orders, or through under-buying caused by undue conservatism which may result in delays to production. It is also perfectly apparent that accounts receivable may be allowed to swell to undue proportions. The point is that it is possible in any business to determine the amount of money which should be represented in each of these forms of working capital for any condition of the business. By drawing graphs for each item on a chart with another graph showing unfilled orders on hand, the executive can check up the condition of his plant quickly. For example, he might receive a report showing a million dollars worth of unfilled orders, half a million dollars worth of raw material and three million dollars of goods in process. By referring to the chart which shows the ideal figures, he may find that for this amount of unfilled orders, three hundred thousand dollars worth of raw material and two million dollars worth of goods in process is the standard.

I am not showing a chart of this sort, for one that would do for one business would be nowhere nearly correct for another. Such a chart would have to be drawn after very careful consideration of what the ideal conditions of operation were for the individual business.

My whole purpose in this article has been, not to recommend any particular charts nor even to recommend the use of charts. It has been my purpose rather to suggest charts that may be of value and to indicate some of the wrong methods as well as the right ones in drawing up and using them. Graphic charts, like cost figures, do not in themselves make profits, but they often serve to point the way to wrong conditions. It is then up to the executive to right these conditions.

Characteristics of the Forged Milling Cutter

Methods of Manufacture—Results of Casting and Forging High-Speed Steel—Structure of Metal—Comparison of Bar Stock and Forged Steel

By WILLIAM G. CALKINS
Metallurgist, Detroit Twist Drill Co.

As a result of the rapid strides which have been made in the past few years in increasing shop efficiency and production, a demand has arisen for a superior grade of milling cutter; one which is able to withstand the highest rates of speed and feed without excessive deterioration, thereby removing metal at the lowest possible cost per unit.

The beneficial effect on steel conferred by the proper forging and mechanical working at correct temperatures is well known. It must be borne in mind, however, that the forging of high-speed steel is an operation requiring a high degree of experience and ability and the operation cannot be compared with the ordinary drop forging of low carbon alloy steels similar to those used in automobile construction.

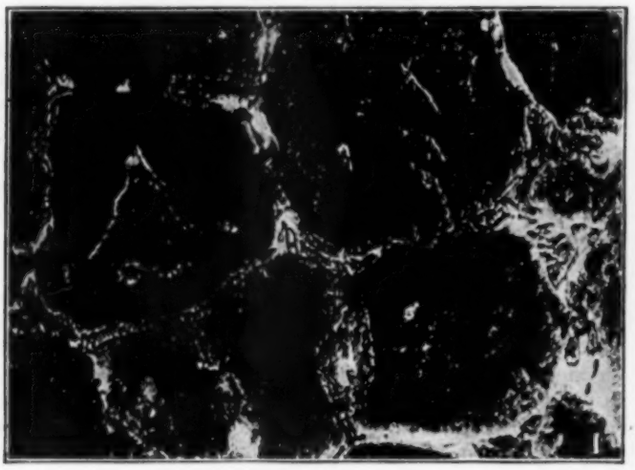
By the term "high-speed steel" we refer to a steel of the high-tungsten, high-chrome type which has been adopted by a majority of reputable tool manufacturers as the material most suitable for the manufacture of the highest quality of cutting tools. The following are excellent minimum and maximum limits for the principal alloying elements in such a steel:

Carbon	0.65— 0.75 per cent.
Tungsten	17.00—19.00 per cent.
Chromium	3.50— 4.50 per cent.
Vanadium	0.75— 1.50 per cent.

This specification does not preclude the possibility of making tools which will perform satisfactorily from the so called "low" or 14 per cent tungsten steels for certain operations, but where the utmost limits of endurance are required in drilling or milling operations the 18 per cent tungsten steel will invariably prove to be superior. The average performance of all the 14 per cent tungsten steel drills which have been tested in this plant (Detroit Twist Drill Co.) has been from 60 to 75 per cent of the maximum obtainable from drills made from the high-tungsten type. Conditions in planing operations are somewhat different and some of the largest machine shops in the country favor the low-tungsten steels for this type of service.

Two methods of manufacture are to be considered in making high-speed milling cutters: (1) Direct cutting from bar stock; (2) upset or forged method.

Before attempting to outline the advantages of a forged cutter as compared to a cutter made direct from bar stock, some consideration must be given to the process of manufacture of high-speed steel with special reference to the internal structural condition.



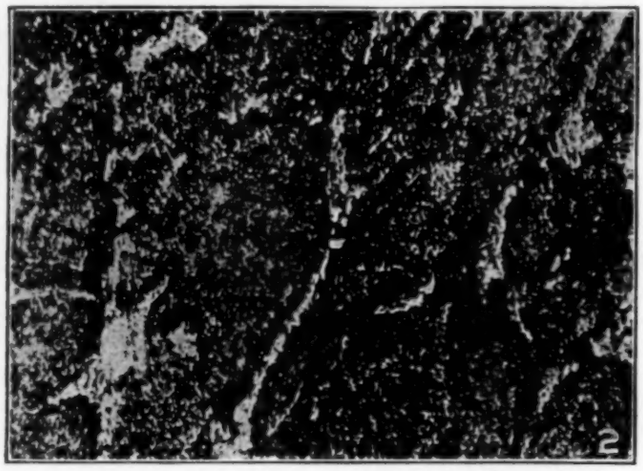


FIG. 1. MICROPHOTOGRAPH OF A HIGH-SPEED STEEL INGOT AS CAST (MAGNIFIED 250 DIAMETERS).
FIG. 2. MICROPHOTOGRAPH OF A HIGH-SPEED STEEL BILLET (MAGNIFIED 250 DIAMETERS)

High-speed steel whether made by the crucible or electric process is cast in the molten state into iron ingot molds. The size of the ingot will ordinarily vary from 3 to 12 in. square with rounded corners and made slightly tapering. It is essential that the ingot be cast as nearly perfect as possible and special attention must be given to the prevention of excessive pipe, blowholes, segregation of certain constituents, etc. Piping is the term applied to the cavity which forms in the top portion of the ingot due to shrinkage as the ingot cools and solidifies. As the central portion of an ingot is last to solidify, it always contains the least desirable structure, which is more coarsely crystalline than the outer portion and also subject to segregation of impurities, slag, et cetera.

When a section of high-speed steel is polished, etched and observed under the microscope highly magnified, it appears to consist of at least two separate and distinct components, one of which is dark in color and the other light. Fig. 1 illustrates the structural condition in the interior of an ingot as cast. Attention is called to the coarse crystalline condition and so called "carbide envelopes" or cellular structure. Steel showing this structure is not suitable for use in cutting tools. These "carbides" are probably mixed complex tungstides and carbides of iron, chromium and vanadium, concerning which the exact chemical formulas are unknown.

The high-speed ingot is then annealed, primarily to assist in emulsifying the cellular structure and to remove internal strains caused by cooling and contraction; also to enable drillings to be taken for purposes of analysis. The next operation is the removal of surface defects such as checks, blowholes, slag inclusions, etc., by grinding them out with portable grinding machines. The annealed and ground ingot is reheated and hammered or "cogged" under a steam hammer and an amount equal to about 20 per cent of the ingot weight is cut from the head or pipe end, in order to eliminate difficulties due to the shrink cavity being rolled into bars causing hollow centers or seams.

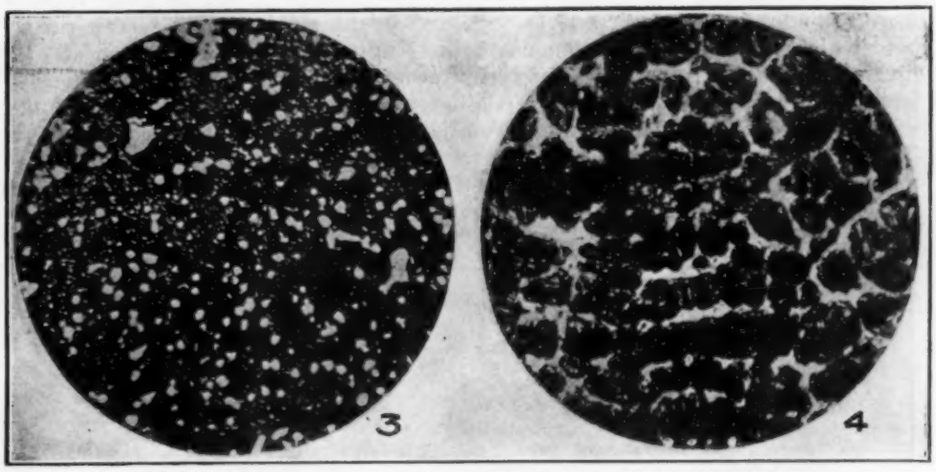


FIG. 3. SECTION OF ¾-IN. H. S. STEEL BAR STOCK, ANNEALED.
FIG. 4. CENTER OF 6-IN. ROUND

The effect of the hammering and reduction breaks up the coarse structure, refining and distributing the carbide and tungstide particles throughout the mass of the steel. The ingot after cogging and cropping is technically known as a billet. The structure of a high-speed billet is shown in Fig. 2. The billets are then annealed and ground in the same manner as the ingots and delivered to the hammers or rolls as the case may be for final finishing to shape and size. After hammering or rolling, the bars are again annealed and are ready for the market. The microstructure of a piece of properly worked annealed high-speed steel is shown in Fig. 3, which is a cross-section of an annealed ¾-in. round bar. Here the particles are small, well broken up and uniformly distributed indicative of correct conditions of manufacture and an ample amount of reduction in size from the ingot. This illustrates the desirable structure for high-speed steel. Large rounds, for instance from 4 to 9 in., invariably show a marked lack of uniformity in structure and the central portions frequently retain the raw ingot structure as result of insufficient reduction. The condition existing in the center of a 6-in. round is shown in Fig. 4, in contrast to the internal structural condition existing in the small bar stock where the percentage of reduction has been ample. In this condition alone lies the great advantage in the use of the forged cutter.

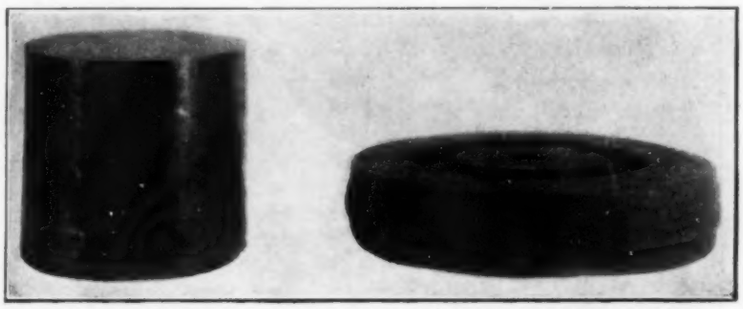


FIG. 5. METHOD OF FORMING A FORGED CUTTER BLANK

FIG. 6. FINISHED H. S. STEEL MILLING CUTTER BLANK

Little explanation is required to make clear the process of manufacture of cutters from bar stock. The material as received, which is only a small fraction of an inch over the diameter of the finished cutter, is cut to the required length and the operations following are essentially milling the teeth to the required shape, hardening and grinding. Structurally the condition of the steel remains the same and it is very evident from the photographs shown that the internal condition of large high-speed rounds is not desirable.

The method involved in forming a forged cutter blank is illustrated in Fig. 5. The bar stock, which is about half the diameter of the desired cutter, is cut to the length required to furnish the necessary material after upsetting. The direction in which work has been applied, however, has been entirely longitudinal or in a direction parallel to the axis of the bar. This fact is sometimes responsible for failure of cutters made directly from bar stock especially in the larger

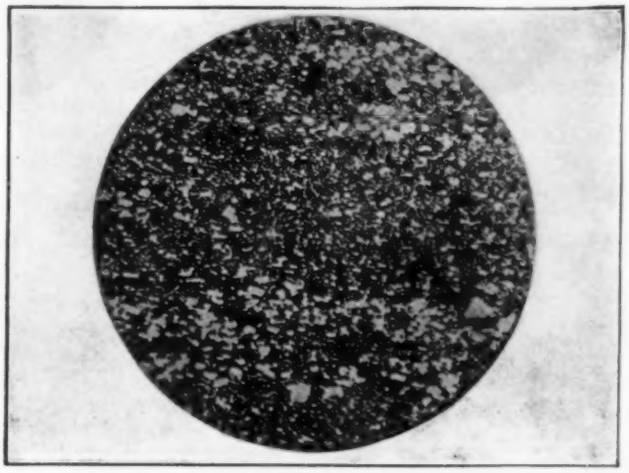


FIG. 7. CARBIDE SEGREGATION IN H. S. STEEL BAR STOCK

sizes, on account of the tendency toward a grain structure which may be described as "woody" or fibrous and which is in a sense analagous to the longitudinal grain in a piece of wood. The tendency toward carbide stringers is shown in Fig. 7 which is a longitudinal section of a piece of high-speed steel from bar stock $\frac{3}{8}$ in. in diameter. Steel showing this effect tends toward planes of weakness along the lines of the segregation, which if present along the cutting edges of the tool may cause flaking off.

It is clear from Fig. 5 that after the cylinder of steel has been cut to length it is hammered and upset in a direction at right-angles to the direction in which work has previously been done. The forging is done at a temperature of approximately 2,000 deg. F. under a steam hammer; the disk being upset to a thickness approximating that of the cutter. It is then reheated and finished in the recessing or forming dies. This procedure squeezes the metal adjacent to the outer circumference into forcible contact with the sides of the die and each blow compresses the metal heavily at the vital points. The excess metal forms a slight flash which is trimmed off later. The extent of the refinement and compression is forcibly brought out in Fig. 8, which is a photograph of the cross-section of a high-speed milling cutter blank in the hardened condition which has been highly polished and then etched to make the structure visible. The microphotographs show the structure magnified fifty diameters corresponding to locations indicated in the photograph of the cutter section. Note the ring of fine grained dense metal extending around the outer edge where the teeth would be cut, and the more open grain in the center. Compare these structures with those of the bar stock cutter in Fig. 9, where the coarse crystalline condition shows the "dendrites" or pine tree crystals, which are indicative of a lack of sufficient reduction and mechanical working of the steel. The magnifications are the same in both cases.

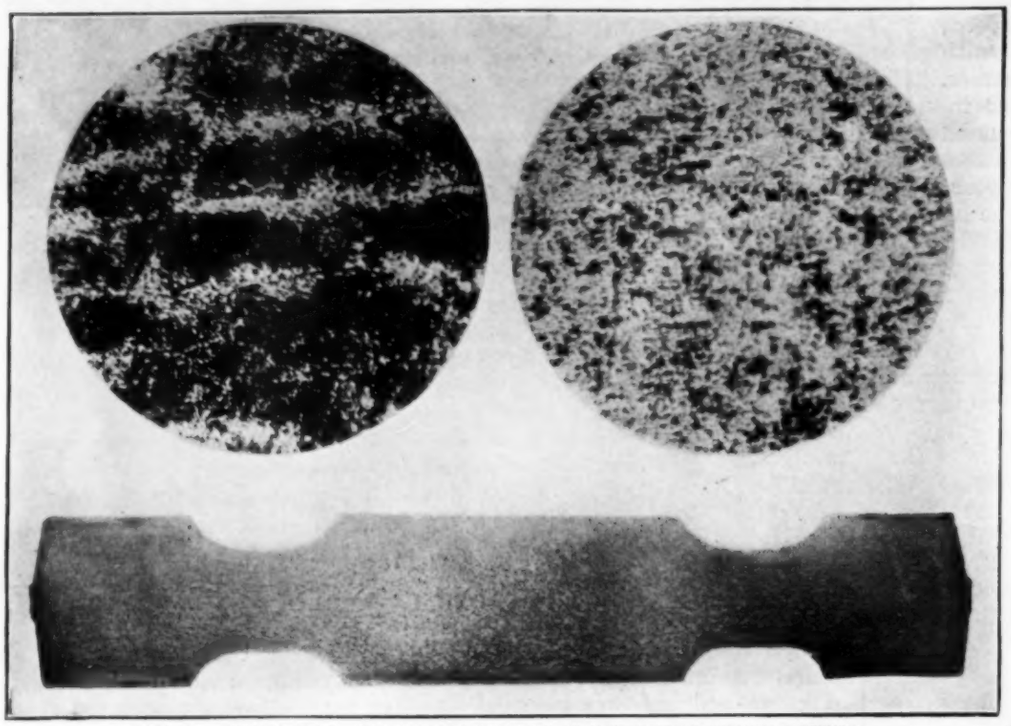


FIG. 8. CROSS-SECTION OF FORGED H. S. STEEL MILLING CUTTER

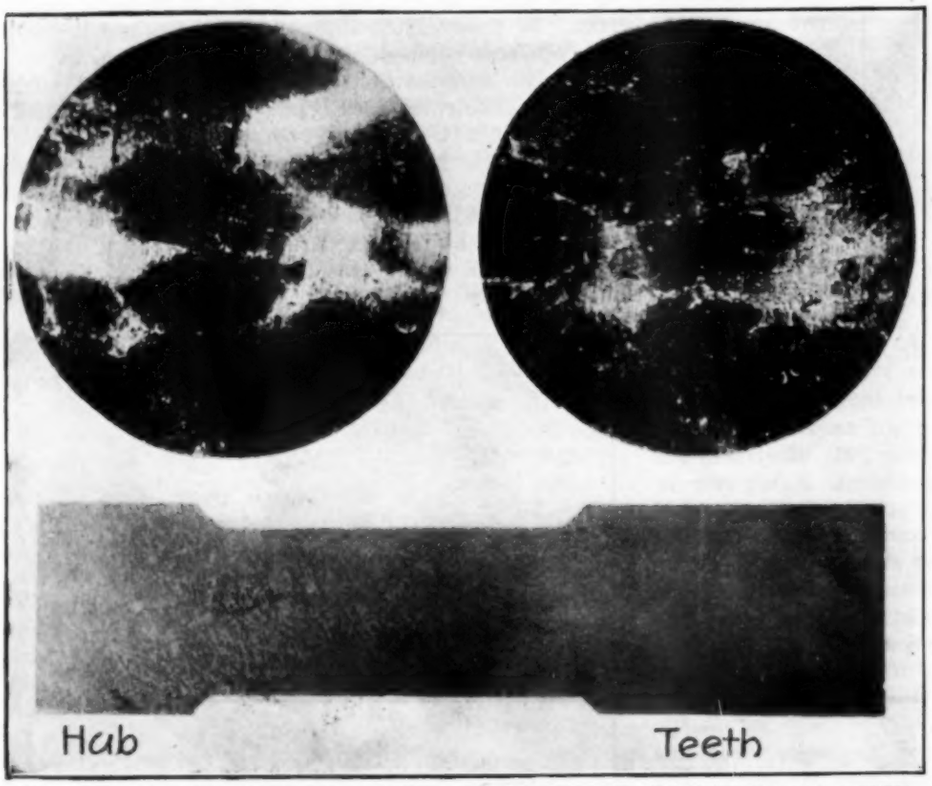


FIG. 9. CROSS-SECTION OF H. S. STEEL MILING CUTTER MADE FROM BAR STOCK

Merely upsetting a bar into a disk or "pancake" between flat-faced hammer dies does not produce the result referred to in compressing the metal heavily at the circumference, as it tends to open up the edges of the disk and the disk is very apt to split radially, as shown in Fig. 10, making the structure porous at the most vital points in the cutter. This difficulty is not encountered in the drop forging process as the metal is forcibly driven into the recess of the dies without the tendency to split.

The forging process for manufacture of cutters while more expensive from a manufacturing standpoint possesses advantages which cannot be overlooked by the user of milling cutters and the fact alone that the

FIG. 10. FORGED H. S. STEEL DISK SHOWING RADIAL CRACK DEVELOPED BY HAMMERING BETWEEN FLAT-FACED DIES

largest users are now beginning to specify forged cutters is sufficient evident that the claims of increased performance made for the forged cutter are being realized.

Reminiscences of an Old-School Machinist

By R. Thomas Huntington

After the closing of the Norris Locomotive Works in Philadelphia, which closing also terminated my apprenticeship, I went to the shop of Norris Brothers in Lancaster, Pa., where I served one year under instructions. The machinery at this shop was more up-to-date than that at the older Norris plant, but the work was handled in much the same way. At this shop my work consisted largely of fitting on the straps at the ends of the connecting rods. I also got considerable repair work to do, some of it of the hurry-up order, and one such job still lingers in my memory.

A yard engine belonging to the Pennsylvania railroad was one day run into the shop for a new pump rod and gland. The rod fell to my lot and the gland went to "Jake," a fellow workman on a nearby lathe. We were both given instructions to work as fast as possible, for there was a yardful of cars waiting for the engine and it was only from necessity that she had been run in.

We had no micrometers in those days; only the old reliable bow calipers to be used in conjunction with our trusty two-foot rules of boxwood. For reamers on brass work we used a tool shaped very much like a blunt-pointed flat drill, and of these we had a fairly complete set, with the sizes plainly stamped on each.

When the foreman had given us the sizes of the required parts we went to work with a will; each striving to get his part done first. Our respective parts finished, we started to assemble the pump and found much to our surprise that the "fit" was worse than before. Being only a cub, I was naturally the first to be suspected, and the boss, to use a now current expression, "lit on me for fair."

Fortunately for me I was able with my rule and caliper to establish a satisfactory defense, whereupon the foreman turned upon the astonished Jake, who promptly produced the "reamer" and showed the figures, which tallied with the boss's instructions.

A little investigation, however, showed that some inconsiderate workman, having wanted a special sized reamer, probably for a hurry-up job, had swaged out the tool a sixteenth or so over-size and forgot to alter the size-mark to correspond.

Great was the wrath of the foreman, who heaped abuse upon poor Jake while he hunted up another casting; but Jake insisted in broken English (he was Pennsylvania Dutch) that "it was not mein fault; it vos de fault of de drill."

I have seen many men since, and they were not all Pennsylvania Dutch by any means, who have similar excuses to put forward when things do not turn out as expected.

Apprenticeship Wasted

When my year was up in Lancaster, I returned to Philadelphia and as a journeyman entered the employ of the Baldwin Locomotive Works, where I found to my sorrow and surprise that the years I had spent learning the trade had been thrown away; for everything in Baldwin's was system and "routine."

I was given a lathe, which stood quite high from the floor, and had a compound slide-rest which was fed by hand. Three jobs were assigned to me, and a certain price was put upon each piece, so that my wages depended entirely upon myself.

One job was to finish from the rough castings the columns, or supports, of the hand rail which ran from the cab of the locomotive to the front of the boiler, so that the fireman could hold on when he was compelled to go forward while on the road. The set of castings comprised two flanges to be fastened to the cab, one on each side of the boiler; six columns about six or eight inches high with a ball on the end of each through which the railing passed; and two acorn-shaped pieces to go in the front end of the pipe rail. All of these parts had to be rough turned, scraped, and polished with oil and emery on a pine stick.

Another job was to turn the tapered end of the bolts which went through the rims of the driving wheels; the points going into correspondingly tapered holes in the steel tire. The tires were pressed on and six holes were drilled and reamed in the tire from the inner side, using the wheel as a drill-jig, in connection with a special drill-press made for that purpose. The holes in the rim of the wheel were threaded, and the bolts came to me, threaded from the rough forging, to be fitted. I had to center them true by the outside diameter of the thread and turn the tapered end to match a sheet metal gage. The turned surface had to be smooth and concentric with the thread.

The third job assigned to that particular lathe, was to lap out, with a wooden lap, the pinhole in the rocker and reverse shaft arms. These arms were about 2½ in. wide by ¾ in. thick and 8 in. long, with bosses forged on each end. The eye where the pin went through was case hardened, very hard, after the hole was machined and then was lapped to size. Great care was taken in welding these arms on to the shaft and rocker, not to heat the bosses hot enough to soften them.

Tools Used in the Manufacture of the P & W Adjustable Limit Snap-Gage

Accurate Alignment a Prime Requisite—A Difficult Piece to Hold and Drill—Tool That Drills a "Cut-Out" or Crescent Shaped Hole

By ELLSWORTH SHELDON
New England Editor, *American Machinist*

THE manufacture of the Pratt & Whitney adjustable limit snap-gage, shown in Fig. 1, involves the solution of several problems that are worthy of the attention of the tool designer, inasmuch as the production of the gage to the necessary degree of accuracy, though not especially difficult where but one or two are to be considered, assumes a different aspect when the quantity runs into the thousands.

The frame of the gage is designed in the form of a truss intended to secure the maximum rigidity for a given weight. The holes for the shanks of the measuring anvils must be in accurate alignment even though separated, in the largest size, by a distance of over 12 in. It is no small problem, therefore, to design a jig that can be quickly and easily handled by the average

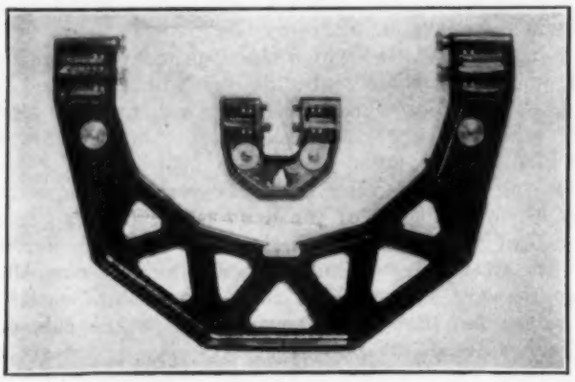


FIG. 1. THE PRATT & WHITNEY ADJUSTABLE LIMIT SNAP-GAGE

workman, yet hold the frame against the drilling pressure without distortion.

Cast iron of special analysis is the material used for the frame for the reason that it is less susceptible to temperature and structural changes than most other metals that would otherwise be suitable. There are several operations upon the casting, such as sandblasting, filing, enameling, etc., with which this article is not concerned, before it comes to the machining department.

The first strictly machine operation is the very simple one of milling the pads upon which are to be stamped the makers name, trade mark and nominal size of the gage. The work is done by straddle mills mounted upon the arbor of a hand milling machine, with the frame held in a clamping device as shown in Fig. 2. This clamp holds all sizes; the smaller ones in the position shown, and the larger ones reversed. The pressure is applied by means of the cam lever to be seen at the left. This cut is made and the stamping of the name and size is done before storing the castings away for a seasoning period of several months.

When the frames are returned to the machining department for the second time they have had two coats of enamel applied and are ready for the few final operations prior to assembling. The most important of these operations, and one for which a very interesting jig is supplied, is the drilling and reaming of the four holes for the measuring anvils and the drilling of four "cut-out" or crescent-shaped holes for the adjusting screws.

The jig is shown in several positions in order to give the reader a clear comprehension of its many admirable features. The drilling pressure is considerable and the frame must be rigidly supported yet be held in such a manner that neither the drill nor the clamps can distort it. All drilling and reaming may be done at one setting and there is no line reaming operation to follow after the frame is removed; yet the alignment, even in the largest sizes, must be so perfect that a hardened steel arbor, ground to exact size, will readily push through the two holes at once while a similar arbor one half thousandth smaller must be distinctly loose in the same position. It should be apparent that the slightest distortion of the frame while in the jig would render the smaller arbor apparently as good a fit as the full-sized one.

There is, of course, a jig for each size of frame, one of the smaller ones being shown in Figs. 3 to 8, and in all these views like reference letters will indicate like parts. The first view, Fig. 3, shows the jig open with a frame in drilling position before any clamps have been tightened. The frame is supported by the body of the jig and has no movement after the clamps are tightened or until all the drilling and reaming is finished.

Two small hardened V-blocks, seen to better advantage at *A* in Fig. 4, receive the bosses at each end of the frame and thus locate the holes central with the bosses. The bow of the frame rests upon a fixed beveled point *B* and is pinched by the point *C* in the swinging bar *D*. The operator places a frame in the jig as in Fig. 3, pressing it forward into the V-blocks, and while holding it with his thumb, lowers the bar *D*, fastening

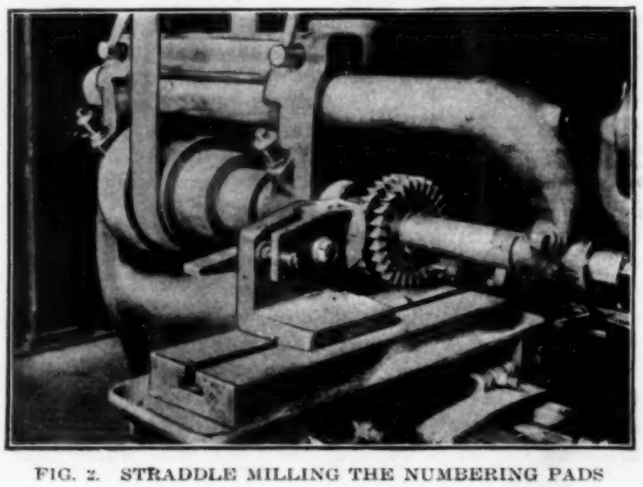


FIG. 2. STRADDLE MILLING THE NUMBERING PADS

it by means of the swivel bolt and thumbnut *F*, Fig. 5. The point *C* is now brought to bear slightly upon the frame by turning it forward by means of the knurled nut *F*.

Referring again to Fig. 4, the parts marked *G G* are swinging yokes, independent of each other and pivoted near the rear end of the jig body. Each yoke carries a pair of blunt points between which the bosses of the gage frame enter. The lower point in each frame is fixed in the yoke while the upper points are adjustable by means of the knurled nuts *H H*. The yokes span the V-blocks and are free to move up or down, adjusting themselves to the position of the gage frame.

The points of the yoke are beveled to an angle of about 60 deg. and are so located that when a frame is resting in the V-blocks the points bear upon the boss beyond its center line, and therefore in pinching them together with the nuts *H H* the points tend to slip over or further encircle the bosses. This draws the latter firmly to a seat in the V-blocks without imposing side strains or twisting effect upon the frame.

After the points in the yokes are tightened by the nuts *H H*, the point *C* is brought to a firm bearing by further tightening of the nut, thus holding the frame by what is practically a three point bearing.

Before any of these points are finally tightened, however, there is another movement that must be made. As the drill works from the outside of each boss (the jig being reversible) the bosses must be supported from the inside against the drilling pressure. Provision is made for this support on all of the jigs; but in the case of the two smallest ones physical limitations made it necessary to put the point of support outside instead of inside the frame.

The possibility of distortion is, of course, much greater this way than if the support were directly under the boss being drilled, for the drill pressure must in each case be borne by the frame, tending to close it together. It was considered, however, that the smaller frames were sufficiently rigid to withstand the pressure without serious deflection and experience has justified the assumption. On all jigs above the second size the work is supported against drill pressure from inside the throat of the frame.

The means of securing this support in two places at once is the same upon the smaller jigs as upon the larger ones; a fixed support is provided at one of the points, and an adjustable support, moved by the lever *I*, at the other. The outer surface of the lug upon which the knurled nut *J* bears, is beveled to a considerable angle so that when the work support upon the inner end of the lever *I* is brought to position by the operator, the tightening of nut *J* tends to bring it up more snugly instead of (as might be possible without the knowledge of the operator) moving it slightly away.

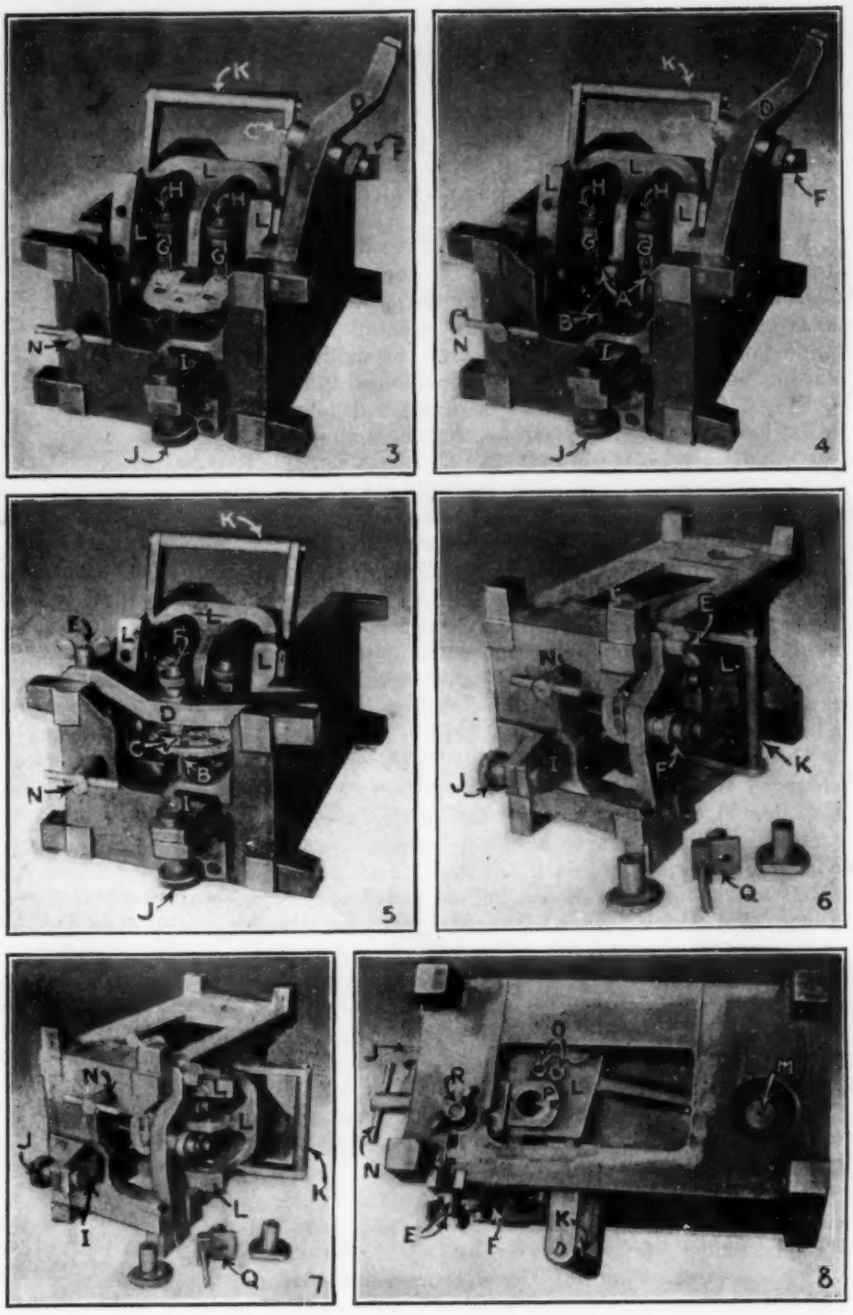


FIG. 3. THE JIG OPEN WITH FRAME IN PLACE. FIG. 4. THE JIG OPEN WITHOUT WORK. FIG. 5. JIG CLOSED WITH FRAME CLAMPED. FIG. 6. DRILLING POSITION, SECTOR BACK. FIG. 7. DRILLING POSITION, SECTOR FORWARD. FIG. 8. TOP OF JIG

In Figs. 6 and 7 the jig is shown in drilling position; in Fig. 8 is a view looking down upon the top. The main locating bushings are all carried in a swinging sector *L*, this letter indicating some part of the sector wherever it appears in the various views. The sector is pivoted at *M* (seen only in Fig. 8) and has three drilling positions in which it is located by the index pin *N* in conjunction with the holes to be seen in one face of the sector. A handle *K* is attached to the sector for convenience of the operator in moving it.

The holes are first rough-drilled in the frame with

the sector in the middle position, the drills being guided by the small fixed bushings in the sector to be seen at *O* in Fig. 8; in this view the sector is not shown in the corresponding drilling position. Sizing drills and reamers are guided by slip bushings all of which may be seen in the foreground of Figs. 6 and 7, and all of which fit the main bushings, one of which may be seen at *P* in Fig. 8.

It will be noted that the heads of the main bushings (of which there are four, two in the top and two in the bottom of the sector) are rectangular in shape, with a locating notch at one side. This locating notch is an important factor in connection with the drilling of the cut-out holes, the slip bushing for which is indicated at *Q*, Figs. 6 and 7, and will be explained later. The other two slip bushings seen are for the sizing drill and the reamer respectively.

The drilling is done on a multiple-spindle sensitive drill press to be seen in Fig. 9. Four spindles are ordinarily used, but at the time the photographs were taken a lot of gages were going through upon which the rough-drilling had already been done in a previous setting as an experiment in production. The rough-drilling would be done with the sector of the jig in middle position, the jig being located widthwise of the table (for all operations) by pushing it against the long raised bar to be seen at the back of the table.

The location of the various holes is shown in the enlarged sketch, Fig. 10. In Fig. 9 the jig is in position for size drilling one of the anvil holes and the sector is pushed back to its limit, exactly as shown in Fig. 6. The size drill is not, strictly speaking, a drill at all but should be called a helical fluted reamer with a long pilot which passes through a permanent bushing in the middle wing of the sector.

After putting through the sizing drill the jig is moved along to the next spindle, the slip bushing changed and the finishing reamer run through. The finishing reamer is piloted the same as the sizing reamer or drill which it resembles, except that it has straight flutes instead of helical ones. Changing the slip bushing again, the jig is moved under the last spindle where the cut-out hole is drilled.

Every toolmaker who has tried to drill a hole that cuts out for about a third of its diameter into a hole already drilled, knows something about the difficulty to be expected. Plugging the first hole and then driving out the partially drilled plug after the second hole is put through, is the toolmakers method; but it would hardly be consistent with economical production where many thousands of such holes are to be drilled.

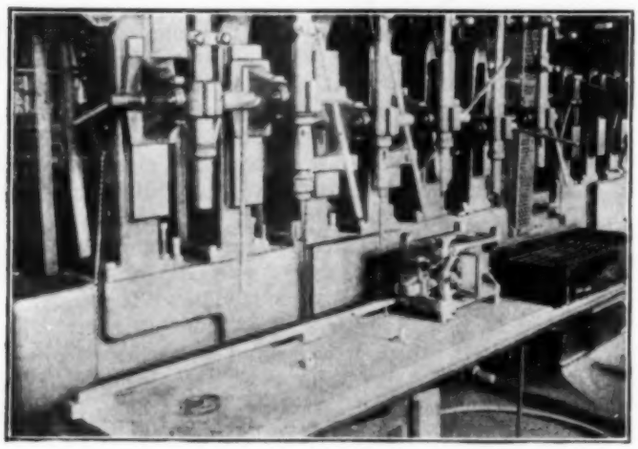


FIG. 9. THE DRILLING OPERATION

There are four of the cut-out holes in every frame, one for each anvil hole, and not only must they be drilled rapidly but they must also be parallel with the anvil hole. The tool for doing the work is shown in Fig. 11.

The lower part *A* of this tool is the guide bushing shown previously at *Q* in Figs. 6 and 7. The upper part *B* is a single piece the function of which is to support the crescent-shaped rod *C* in its proper relation to the drill. The drill itself, marked *D*, is a piece of drill rod with about ¼ in. of the lower end milled or filed to form the lips of a flat drill. It is, in fact, exactly what a toolmaker would call a spotting drill, except that the angle of the point is rather flatter than it would ordinarily be made for that purpose. The part *C* is a hardened steel rod of a diameter that closely fits the reamed anvil hole in the frame (and also as a matter of course, the corresponding hole in the guide bushing *A*, through which it passes). One side of this rod has a semi-circular groove, running its full length, of the same radius as the drill and of a depth equal to the amount that the drill "cuts out" into the anvil hole of the frame. The hole in the guide bushing *A* is of the same shape —something like a figure 8—as the finished hole in the gage frame. The collar *E*, secured to the drill by a setscrew, supports the part *B* and consequently the crescent-shaped rod *C* so that the lower end of the latter is ⅛ in. in advance of the cutting lips of the drill; the groove in which the drill lies being relieved slightly for ¼ in. so that the cutting edges will not drag on the hardened steel and become dulled.

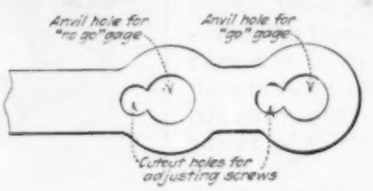


FIG. 10. OUTLINE OF HOLES DRILLED

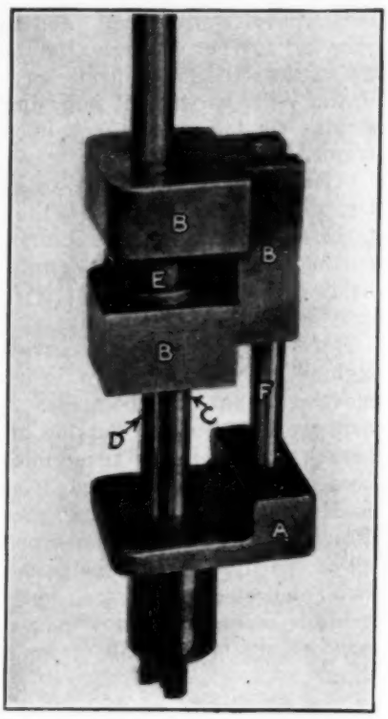


FIG. 11. THE "CUT-OUT" DRILL FOR DRILLING THE OFFSET HOLES

In operation the jig is moved under this spindle, the bushing *A* (*Q* in Figs. 6 and 7) fitted to the bushing of the jig and positioned by a pin on the under side of the head, entering the notch in the head of the die bushing.

The tool is now brought down by means of the feed lever of the machine until the rod *C* and drill *D* enter the hole in the bushing; the guide pin *F* in the bushing at the same time enters the notch in the back of part *A* to keep the latter from revolving. Continuing the downward movement of the spindle the drill cuts through the metal of the frame as readily as if it were cutting

through solid metal instead of working a third of its circumference "in air."

The drill is at all times supported by the rod *C* against the tendency to run out into the previously drilled hole, and though the average toolmaker would say without

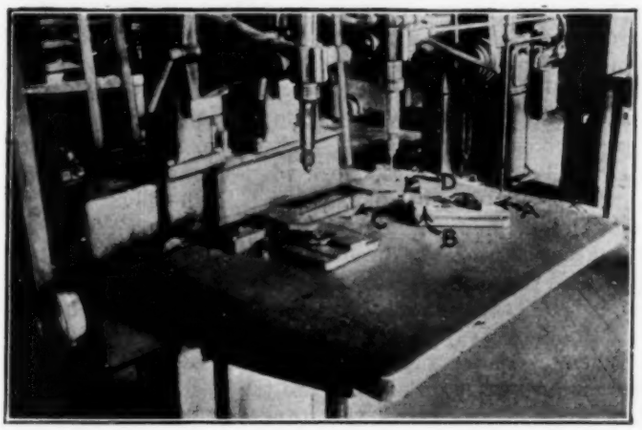


FIG. 12. DRILLING THE STOP-PIN HOLES

hesitation that such a tool would jam and break before drilling more than a quarter of an inch, it has now been constantly at work for many months and shows no tendency to jam unless the cutting edges are allowed to get dulled.

Having completed one hole, or rather two holes in one, the jig is moved back to the first spindle, the sector *L* swung forward to the position shown in Fig. 7 and the sequence repeated, thus finishing the two anvil holes and the two offset holes upon one end of the frame. To drill the holes in the other end of the gage frame the other side of the jig is turned up and the sequence twice repeated; completing all of the drilling on the frame at one setting.

The Final Operation

The final machine operation on the frames is the drilling of the eight small crossholes for the pins against which the adjusting screws bear. Though this operation is a very simple one, much thought has been given to the jig design for the purpose of simplifying the movements and keeping the production cost to the lowest limit.

The operation is shown in Fig. 12 with two of the jigs upon the table of the drilling machine. A jig is required for each size of frame and the work is supported by plungers entering two of the anvil holes and by a third fixed point upon which the bow of the frame rests.

A frame is placed in the jig by slipping one of the anvil holes over a short fixed stud projecting from the boss *A*, drawing back the spring plunger in boss *B* dropping the frame into place and allowing the spring plunger to come forward, entering the anvil hole at that end of the frame.

No fastening is necessary as the gage is held against sidewise movement by the plungers. The drill bushings are permanently fastened to the drill press table, the jigs being correctly located by pushing it against the back bar and against the stop-pin *C* for one hole and against the stop-pin *D* for the second hole. Turning the jig end for end the sequence is repeated, finishing four stop-pin holes. A distance piece is now placed against the back bar on the machine table and all the movements repeated, drilling the eight holes in little more time than is required to describe the operation.

This completes the frame so far as machine operations are concerned. There are no tapped holes, the adjusting screws bearing in threaded grooves in the stems of the anvils.

There are, however, a number of interesting operations in the making of the anvils, and these will be taken up in detail in another article.

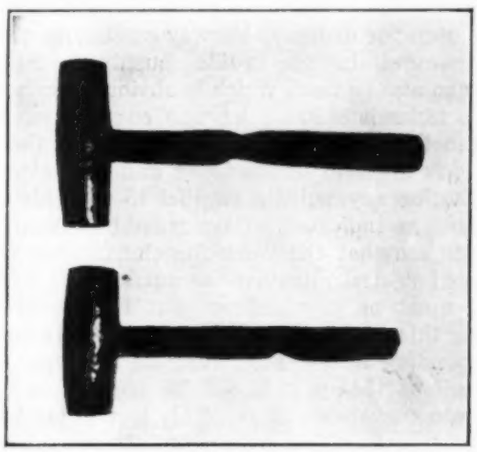
Are Hollows Worn in Hammer Handles?

By F. W. Bach.

L. L. Thwing asks on page 980, Vol. 54, of *American Machinist*, if any one has seen a hammer handle that showed finger prints or other wear from the friction of the hand? He thinks that it would be possible only where the hand was covered with some gritty substance, but I will endeavor to convince him that it is done with the hand oily and smooth.

Several years ago, I worked beside a man who was doing light riveting of typewriter parts. Stubs wire was used for the rivets and great care was needed to make a free moving bearing, so a very small and light flat hammer weighing but a few ounces was needed. The hammer had a hickory handle which was held loosely between the fingers and thumb to get the delicate balance required.

The continuous movement and friction of the oily hands (clock oil was used) day after day for several



HAMMER HANDLES WORN BY THE FINGERS

years had worn such hollows in the handle that the latter eventually broke.

Another case in the same shop where not so much delicacy was required, showed the same results where a larger hammer was held loosely in the hand.

Later, while working at the gun business where the gun barrels were straightened with a hammer, one of the old-time barrel straighteners who used the block and hammer to straighten, had the hammer shown in the cut which weighed about 5 lb. As he had for years done only finish straightening and mostly on shot gun barrels, which required a delicate balance of the hammer, he also held his hammer loosely. His hands generally were greasy from the work and were calloused where the handle had moved on them.

On rough straightening the hands are sometimes gritty, but then the hammer is gripped tight and there is not much wear on the handle.

Tool Engineering

By ALBERT A. DOWD and FRANK W. CURTIS

(Continued from last week's issue.)

SEVERAL examples of keyway broaching are shown in Fig. 191. The ordinary method is illustrated in the example *A*, which is being cut by broach *D*. The work is located on a bushing *B* which is fastened into the faceplate of the machine. This bushing is so made that the broach fits a slot in it at *C*, thereby guiding and supporting it at the same time. This method is

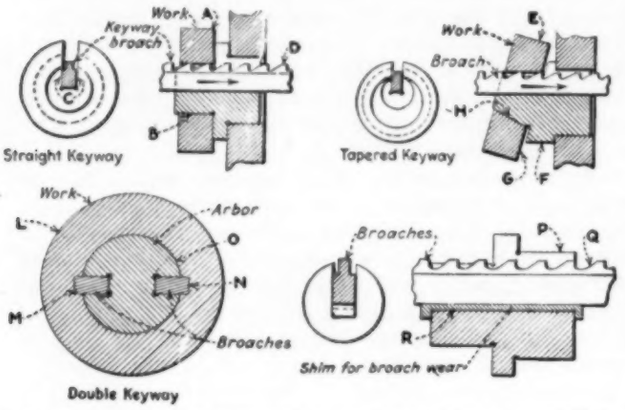


FIG. 191. VARIOUS METHODS OF BROACHING KEYWAYS

generally used for ordinary keyway cutting as the only fixture required is the guide bushing. Standard broaches can also be used, which is obviously economical.

When a taper hole has a keyway cut in it as shown at *E*, the method used is the same except that the guide bushing *F* is made to fit the taper and it is also tilted so that the keyway will be parallel to the side of the tapered hole as indicated. Care must be taken by the designer to see that the work fits the tapered portion *H* yet does not strike against the surface *G*. Sufficient clearance must be provided so that there will be no chance for this to happen; $\frac{1}{16}$ or even $\frac{1}{8}$ in. is none too much, depending on the angularity of the taper.

An excellent idea which can be applied to certain kinds of work is shown at *P*. This is a guide bushing in which the broach *Q* is operating. It is evident that as the broach or bushing wears, the keyway will become shallower and eventually will not be deep enough to pass inspection. By providing a shim at *R*, adjustments can be made as desired by placing paper or thin metal between the shim and the body of the bushing, thus raising it up and prolonging its usefulness.

Referring to the work shown at *L*, attention is called to the two keyways at *M* and *N*. In broaching a piece of work like this two methods are possible; a bushing can be made like that at *O* and two separate broaches used at *M* and *N*, in connection with a coupling like the one illustrated in Fig. 196; or a broaching bar can be made up with two inserted broaches in their correct positions, and the work done without resorting to a guide bushing. Either of these methods will produce good work.

In broaching square holes the work must first be prepared for the operation by drilling a hole and facing one side square with the hole. As a general thing the corners are not quite square, as a sharp corner would be hard to keep up and also it might cause trouble in hardening if the work were to be heat-treated. The sides of the hole are also relieved slightly in order to obtain a better bearing on the shaft and likewise to relieve the cut somewhat while broaching. This is clearly shown in the work *A* in Fig. 192. Starting with the hole as at *B*, the work when about half finished would appear like the diagram at *C*. The illustrations at *D* and *E* show the general form of broach used for this kind of work. The method used for setting up the work is the same as those mentioned and shown under the descriptions of broaches which do not require guide bushings.

When a square tapered hole is to be broached the work must be set up so that the taper of the corner of the hole is parallel with the spindle of the machine as shown at *F* in the same illustration. An indexing fixture must be made for work of this kind and the broach itself must be so designed that it is of the form shown at *G*. The cut should extend slightly beyond the center of each side. It is of the greatest importance for the designer to remember that the angle at the corner of a square taper hole is not the same as the angel of the sides. It is a compound angle which is not usually given on the blue print of the part; therefore it must be figured out by trigonometry.

Broaching Fixture for Connecting Rod

The crank pin and piston pin holes in connecting rods for automobiles are frequently finished by broaching. A fixture for this purpose is shown in Fig. 193. The fixture itself is very simple and yet it is effective and

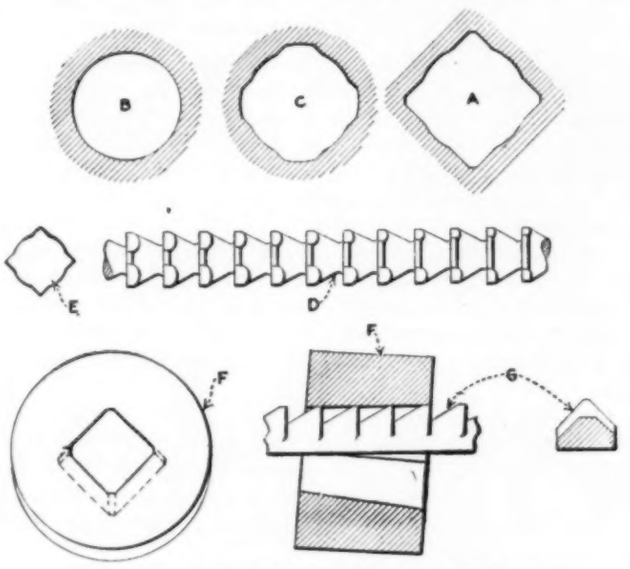


FIG. 192. BROACHING SQUARE HOLES

accurate. The two connecting rods *A* and *B* are located on studs at their upper and lower ends, one large end and one small end of each rod being broached at the same time as indicated at *C* and *D*. The locating plugs are correctly located in the faceplate *E* which is positioned by means of the plug *F* against the faceplate on the machine. A large and small broach are used

simultaneously, after which the connecting rods are transposed while the other two holes are broached.

Broaching Fixture for a Ratchet Sector

Fixtures for broaching use many of the devices which have been previously illustrated and the principles of holding and clamping can be applied to this type of fixtures as well as to the others. There are, however, peculiar conditions to be met in the design of fixtures for broaching and these can best be appreciated by citing suitable examples. The matter of removing and

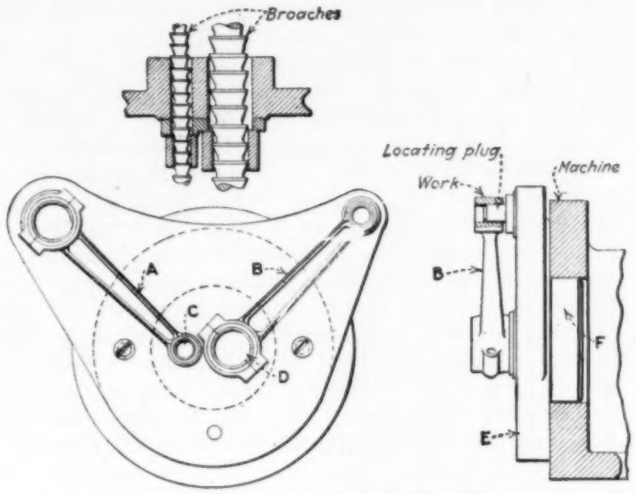


FIG. 193. DOUBLE BROACHING FIXTURE FOR TWO DIFFERENT SIZE HOLES

replacing the broach after each operation sometimes takes time which can be avoided by a little thought on the part of the designer. An example of this kind is given in Fig. 194, the work *A* being a ratchet sector of which four pieces are to be broached at a time as indicated. The work is set up in the swinging locater *B* which rests on a lug *O*, and is pivoted at *D* in such a way that it can be swung over into the broaching position when desired and located by a pin at *F* which corresponds to *G* on the faceplate as shown. In the loading position, the clamp is pulled back as shown by the dotted lines at *K* while the work is being placed on the two pins at *X* and *Y*. The clamp is then tightened and the work is ready to be swung into place when the other pieces are finished. While the loading of one group of pieces is proceeding the other set is being machined, being held in the other swinging member *C* and located by the dowel pin at *H*. The clamp *L* holds the four pieces firmly and the broach *M* cuts the serrations shown. A bracket *N* is mounted on the face of the plate to act as a guide and support for the broach. After the pieces have been machined the swinging member *C* is turned over until it rests on lug *P* where the pieces can be removed and replaced by others.

As the broach used for this operation is a heavy one it is advisable to support the outer end on the sliding support which can be obtained as a part of the broaching machine equipment. With a fixture like the one shown, however, it is unnecessary to remove the broach at all and consequently the only time lost is in the return stroke of the broach and the swinging into place of a fresh group of pieces. Arrangements of this kind are sometimes possible when work does not have a hole in it through which the broach must pass.

Certain kinds of work must be located in a fixed relation to each other when they are installed in the mechanism of which they form a part. It is therefore a decided advantage to take this into consideration when designing tools for these parts. An example of this kind is given in Fig. 195, the work *A* and *B* consisting of two automobile timing gears. A definite relation must be kept between the keyways which are to be broached and the teeth which have been previously cut. In addition to this each gear must be properly marked in a particular place so that when the two gears are assembled in the car the gears can be meshed at these points, thus assuring the correct position of the cams on the camshaft in relation to the throws of the crankshaft.

The work is located on two studs, the locating pins at *C* and *D* being provided to determine the relation of the keyway with a given tooth. The method used is apparent from the illustration. The marking of the teeth is done by the swinging arms *H*, each of these having in it a pointed pin *K* which, when struck with a hammer, makes a mark on the gear. After the marking has been done the arms are swung out of the way so that the gears can be readily removed. The principles illustrated here can be applied in other cases where the location of the keyway must be kept in relation to some other part.

Examples of Index Broaching

Index broaching is of various kinds and the requirements are also varied. In one case accuracy may not be of the greatest importance, while another may require the greatest care to produce it within the

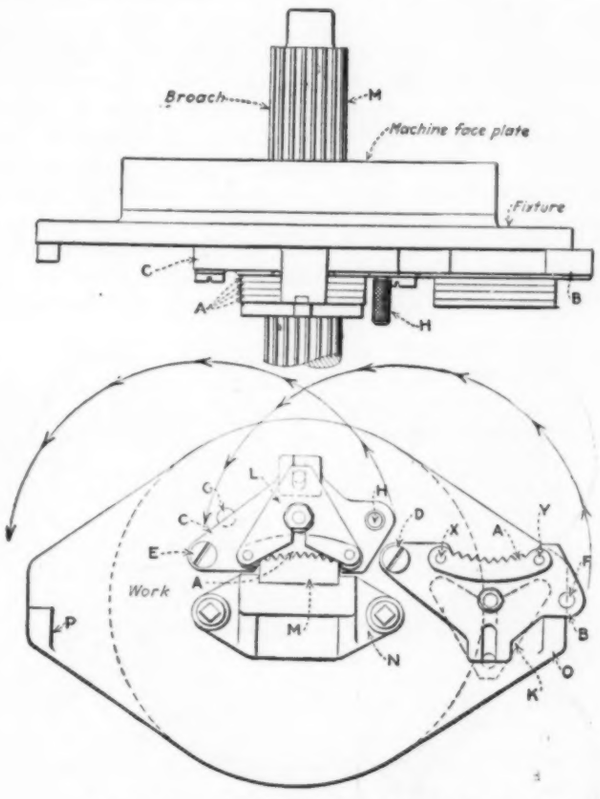


FIG. 194. BROACHING FIXTURE FOR RATCHET SECTOR

necessary limits. These points must be considered when designing fixtures for any kind of an operation. So far as the fixtures are concerned the indexing

devices which have been described in previous articles cover the situation quite thoroughly, so there is no necessity for repetition. Several examples of work which may require an indexing device of some kind are shown in Fig. 196. The work *A*, for example, is

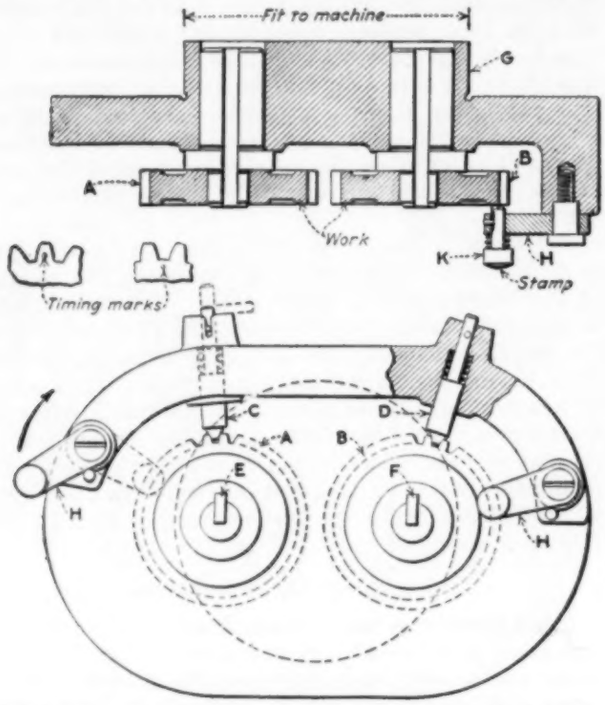


FIG. 195. BROACHING FIXTURE FOR TIMING GEARS

of such large diameter that it would hardly be desirable to make up a four spline broach, both on account of its weight and also the expense. It is evident therefore that an indexing device would be of assistance in a case of this kind. A method is illustrated in order to point out the errors into which a tool designer may fall unless he analyzes a situation carefully. Let us assume that the work is set up on a guide bushing so that a broach can be used as at *F*. If then the guide bushing has a slot *G* located at 90 deg. from the one which is used as a guide for the broach, it would appear

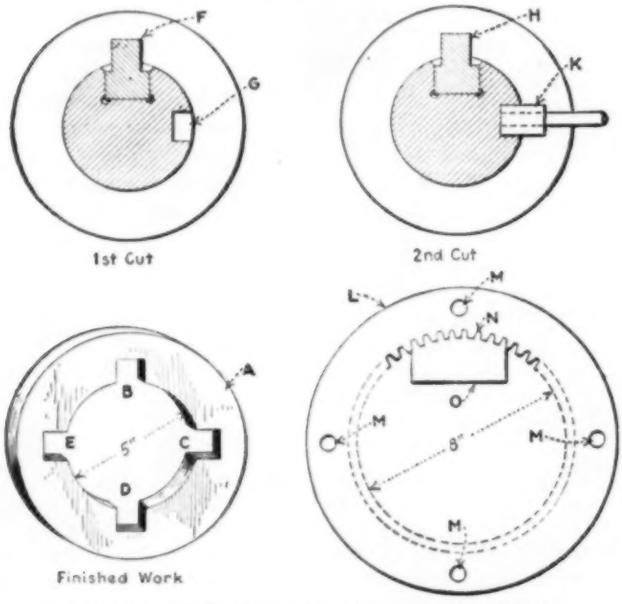


FIG. 196. EXAMPLES OF INDEX BROACHING

that the work could be turned around on the bushing to take another position and located with a plug as at *K*. With this plug in place a broach cut could be made as at *H*, and the operation could be repeated to finish the other keyways. If the work *A* is to be machined at *B*, *C*, *D* and *E* it is apparent that any slight error in location of the plug *K* would cause an error which would become more and more as the work is turned around, so that the piece when completed might be valueless. Hence, it is seen that a method of this sort is not good practice and will not produce accurate work.

An index fixture of simple design could be used with much more satisfactory results, and although it might be a little more expensive than the method illustrated, the product obtained would pass inspection. Another example of work which requires indexing is shown at *L*, which is an internal gear of large diameter. The work is to be done by the broach *N* which is so designed that it will cut a number of teeth at one time. The work can be located on pins in the holes *M* on a simple index plate so that the successive broaching operations will produce a finished gear. Any good method of indexing can be applied to a piece of work like this, although it is essential to use a method which will not multiply the error as in the instance just mentioned. An indexing fixture should be made up with the indexing bushings or slots as far away from the center as possible in order to insure accurate work.

When the use of a heavy broach is necessary the weight of the overhanging portion of the broach is

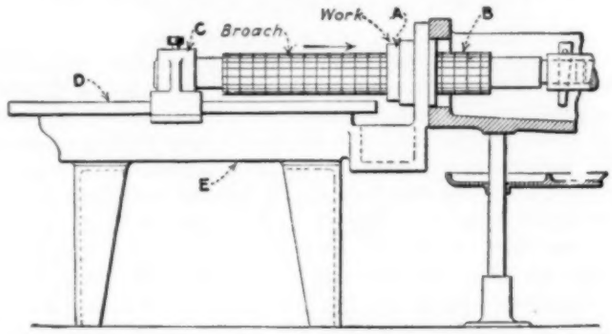


FIG. 197. OUTBOARD SUPPORT FOR HEAVY BROACHING

likely to be a matter of serious moment. It is evident that if it is to be supported at all it must be done by some arrangement which will permit it to be aligned properly, or else the work produced may be inaccurate. When one hole is to be broached in accurate relation to another accurate alignment is also necessary, so that in each of these two cases it is well to use the outboard support.

An example which shows the application of this device is illustrated in Fig. 197, the work *A* being similar to the internal gear shown in the preceding illustration. In this case, however, the broach is so made that all of the teeth are cut at the same time, and as a consequence the broach is both large and heavy. The support *E* is provided with a slide *D* on which is mounted the member *C* which holds one end of the broach as indicated. Provision is made so that proper alignment can be obtained without difficulty.

SPIRAL BROACHING

When it is necessary to broach a spiral, two methods are possible; the broach may be arranged so that it will revolve while cutting, or the work may revolve

while the broach is passing through it. In Fig. 198 two examples of spiral work are shown at *A* and *B* and one method of broaching is shown. The work *A* is mounted on the broach *C* so that the pulling action comes against

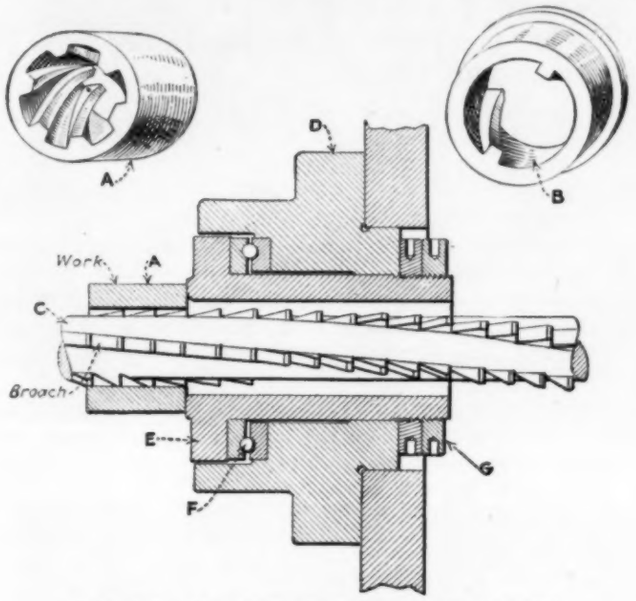


FIG. 198. METHOD OF SPIRAL BROACHING

the face of the bushing *E*. This bushing is adjusted by the two check nuts at *G* so that it will revolve freely and all of the thrust is taken on the thrust bearing *F*. The fixture *D* is mounted on the faceplate of the machine and fastened by means of screws.

In operation the angularity of the broach teeth causes the work to revolve so that the spiral is cut without other assistance.

We Pay for Human Energy

By A. N. Goddard

President, Goddard & Goddard

In the ultimate analysis of all industry the one thing we pay for is *human energy*. The three factors usually considered in figuring the cost of a commodity are material, labor and overhead. Overhead involves the expenditure of human energy; mentally in administration, supervision and sales. Labor involves the expenditure of human energy; physically, on the part of the workman, and the raw material of one industry is the finished product of another.

Connection of Raw Materials and Direct Labor

Milady's muslin dress is the finished product of the dressmaker, involving the direct labor of the seamstress and raw material of the muslin. Muslin is the finished product of the cotton mill, involving the direct labor of the operator and the raw material of the cotton field. Cotton is the finished product of the cotton grower, involving the direct labor of cultivation and raw material of seed and soil. This takes us back to Mother Earth, nature's supply, but available for man's use only by the expenditure of human energy.

The watch you carry is a composite of many different raw materials and the direct labor (human energy) of fabricating and assembling. The hair-spring involves the direct labor of the operator and raw material of high-grade spring steel. Spring steel is the finished product of the steel mill, involving the direct labor of the operator and raw material of pig iron. Pig iron is the finished product of the blast furnace, involving the direct labor of the workers and raw material of ore. Ore is the finished product of the mine, the gift of nature's wealth and the expenditure of human energy in the process of mining.

Saving Human Energy a Benefit to All

When human energy is saved, shrinkage in economic waste is brought about, resulting in easier conditions of living. Necessities of life are cheaper, cost of luxuries are brought within the range of a greater number, and happiness is increased.

We as mechanics, fabricators of the world's goods, have a distinct responsibility at all times, and this is greatly increased in the days of rehabilitation before us. It is our duty to study in detail the problems of production that come under our own personal supervision and see to it that we are rendering a worthy account of our stewardship by the saving of human energy through the application of better methods, and the use of better tools.

The Value of Good Tools

Better tools are not necessarily cheaper in dollars and cents of first cost but are actually cheaper, because of longer ultimate life and increased production possible with their use. Many a shop in this country today is trying to manufacture with tools that would actually pay bigger dividends returned to the cupola than on the shop floor. And we are increasing economic waste just so long as we allow them to remain on the shop floor or in the toolcrib.

Let us have the courage to do and do now the thing which down deep in our hearts, we know should be done. Don't let us fool ourselves—the inexorable law of the survival of the fittest will apply with relentless force in the days to come. It lies within our own power to determine whether we will be among the fittest and thus not only survive, but progress; or whether we are content to retrogress and die.

Converting an Old Planer Into a Broaching Machine

By John A. Yungivirth

In visiting a small shop where they were manufacturing quite a few parts requiring internal keyways, I discovered a novel method of cutting keyways and doing light broaching when no broaching machine is available. In this shop they had an old planer that had seen its best days but was still capable of giving further service as a broaching machine. All that is required is an Armstrong planer tool and an angle plate.

The tool clamping stud is removed from the toolholder and the latter is bushed to receive a standard La Pointe broach which is inserted and tightened with a nut. The angle plate is bored to receive the broach guide and is fastened to the planer table.

The broaching is done on the cutting stroke and the table is stopped on the return stroke by arranging a stop on the belt shifter so that the belts shift to the loose pulleys.

In the small shop that cannot afford modern equipment this method works very satisfactorily and certainly beats the old stand of poking out keyways in the shaper.

Machining the Peerless Lower Crankcase and Front Cover

Fixtures That Make Handling Easy for Different Operations — Boring Difficult Holes and the Gages for Inspecting Them

BY FRED H. COLVIN
Editor, *American Machinist*

THERE is much less machining on the lower half of the crankcase than on the upper, it being in reality little more than an oil pan with a sump from which lubricating oil can be pumped to the different bearings of the motor. This part is also an aluminum casting and the sequence of operation is as follows:

Operation 1—Mill top side.
Operation 2—Mill ends.
Operation 3—Mill bottom.
Operation 4—Mill slot on top side.
Operation 5—Drill all holes excepting four flanged bolts.
Operation 6—Drill twenty-two holes in flange.
Operation 7—Tap holes.
Operation 8—Bore two lower halves at center in one operation.
Operation 9—Mill at right-hand side.
Operation 10—Bolt two halves together.
Operation 11—Bore and face rear end and face front end.
Operation 12—Drill rear end.
Operation 13—Drill front end.
Operation 14—Tap front and rear ends (the four operations (Nos. 11 to 14) are performed while bolted to the upper half and have been accounted for in the previous article).
Operation 15—Unbolt lower half.
Operation 16—Solder sand and blow holes and file burrs.
Operation 17—Inspection.

Milling the upper side is shown in Fig. 1, which also shows the construction of the holding fixture with its plungers on each side to resist the downward thrust of the milling cutters. These plungers are adjustable by means of the knobs shown and support the cases in a satisfactory manner.

The ends are milled on angular fixtures, similar in design to those used for the upper half of the crankcase. These fixtures are shown in Fig. 2 and need no explanation.

The drilling fixture, which resembles that for the upper half of the case, is shown in Fig. 3. This view also shows the transfer table at *A*, the saddle which carries the drilling bushings at *B* and the tool stand at the right. This setting takes care of drilling twenty-eight holes, some of which are reamed and a few of them tapped.

Next comes the drilling of the bolt holes in the flange, Fig. 4, the fixture being simply rolled over to present the proper bushings to the drilling spindles.

After several holes have been tapped, two of the lower halves are clamped together as shown in Fig. 5 and both bored at one setting in the fixture shown. This is done under an American radial drilling machine in the arched shaped fixture shown, the boring bar being guided in the usual manner.

Although a comparatively small piece there are twenty-two operations on the crankcase front cover, as follows:

Operation 1—Mill rear sides.
Operation 2—Mill pad at crankshaft hole.
Operation 3—Mill pad at fanshaft hole.
Operation 4—Mill pad at water-pump bracket.
Operation 5—Mill tire-pump pad.
Operation 6—Drill and ream 2¼-in. dowel holes.
Operation 7—Mill generator pad.
Operation 8—Bore and ream crankshaft and fanshaft holes.
Operation 9—Drill thirty-three holes at various places.
Operation 10—Drill twenty-one holes.
Operation 11—Tap sixteen holes.
Operation 12—Bolt clamps to cover.
Operation 13—Bore, ream and face crossshaft holes.
Operation 14—Drill eight holes at crossshaft holes.
Operation 15—Drill two holes in generator pad.
Operation 16—Drill dowel and oil-holes in water body clamp.
Operation 17—Spot-face eighteen holes on front side.
Operation 18 } —Tapping
Operation 19 }
Operation 20 }
Operation 21—File off all burrs.
Operation 22—Inspection.

The design and the distribution of metal in the crankcase front-cover make it quite a problem to hold satisfactorily in a fixture, so as to withstand a heavy cut. The design of the fixtures is shown in Fig. 6 which also shows the cover both in and out of place. The light flange around the outside of the cover helps to take the downward thrust of the milling cutter and several of the pads on the castings are utilized in this same way.

The upper hole through which the fanshaft projects is utilized for clamping at *A* while the plungers *B* and *C* support both bosses as can be seen at *D*. Setscrews

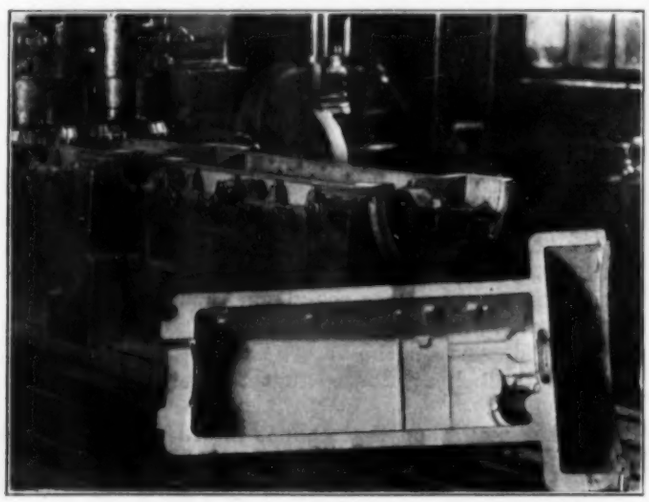


FIG. 1. MILLING TOP SURFACE.

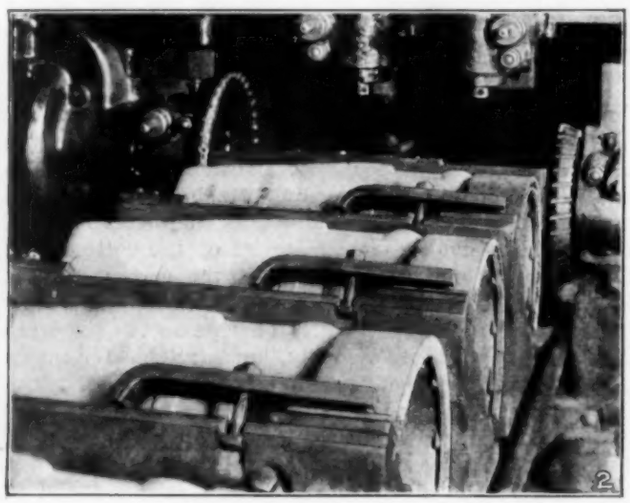
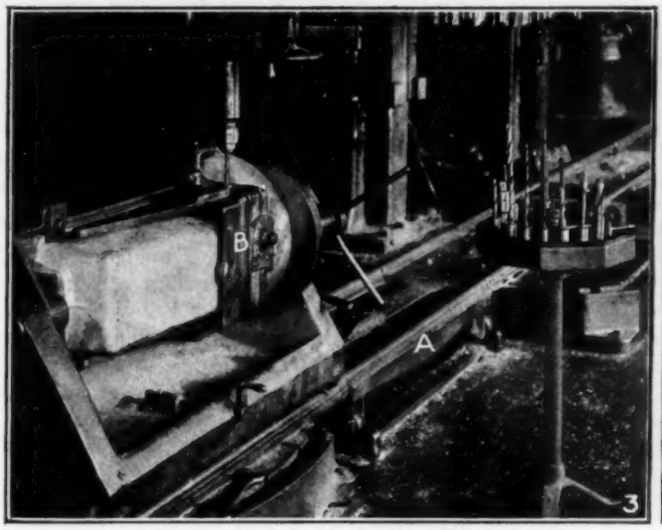


FIG. 2. MILLING THE ENDS



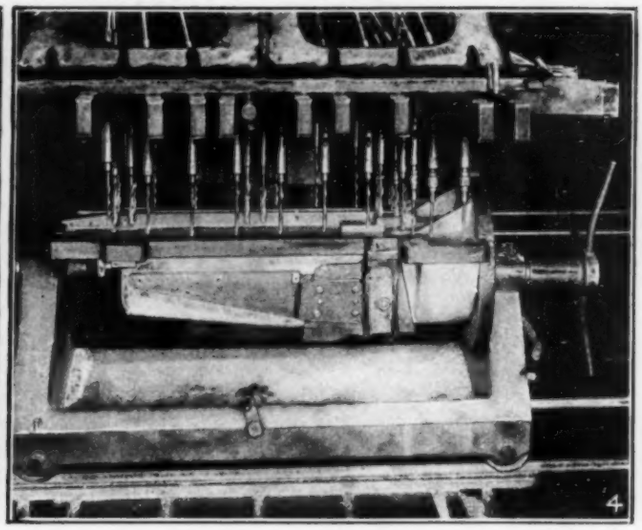
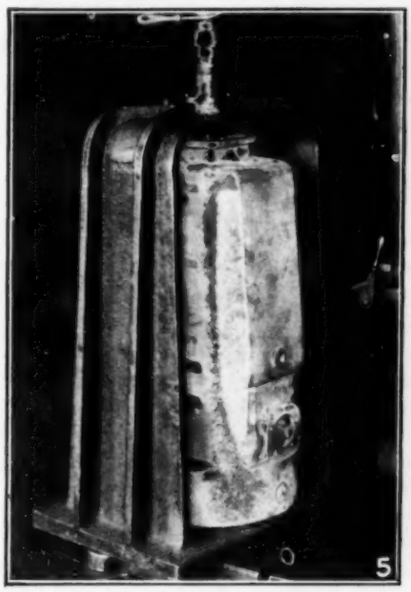


FIG. 3. DRILLING THE SIDE HOLES. FIG. 4. DRILLING THE FLANGE HOLES



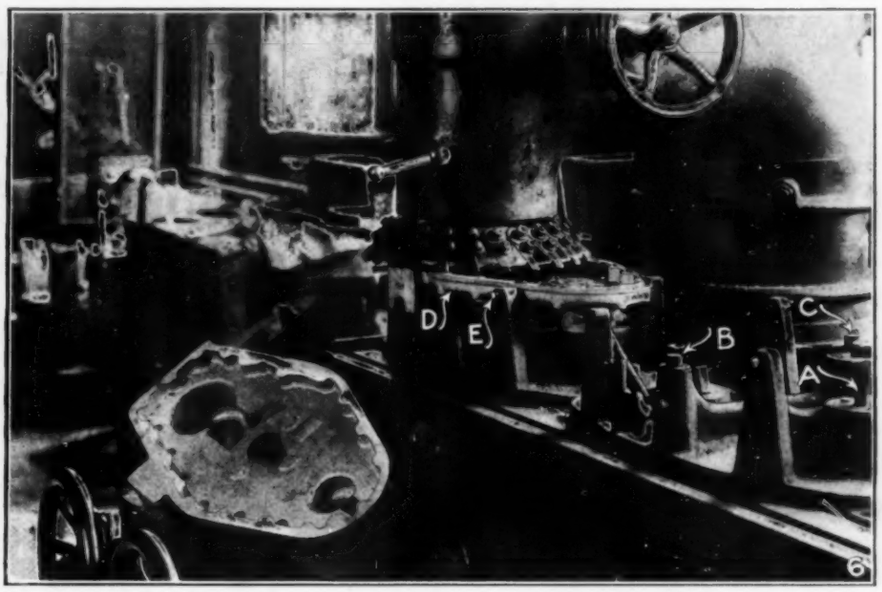
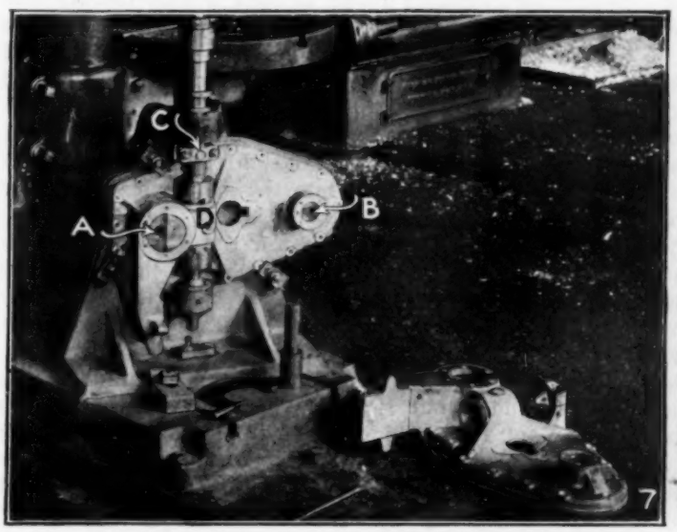


FIG. 5. BORING TWO LOWER CASES AT ONCE. FIG. 6. MILLING FRONT END COVER



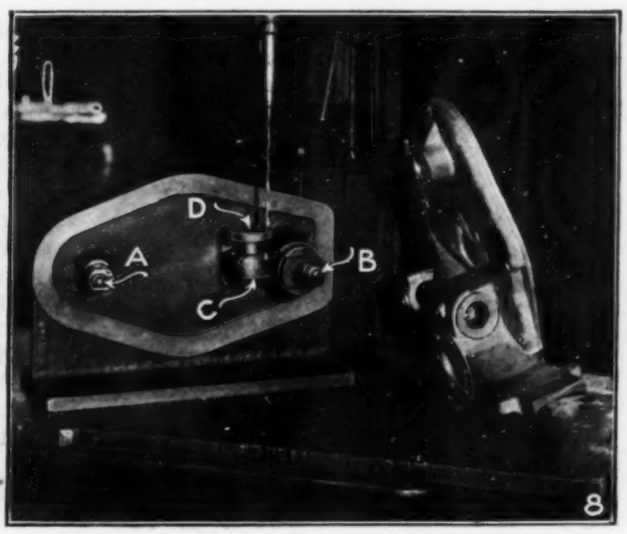


FIG. 7. BORING AND FACING CROSSHOLE. FIG. 8. DRILLING FIXTURE FOR CROSSHOLE FLANGE

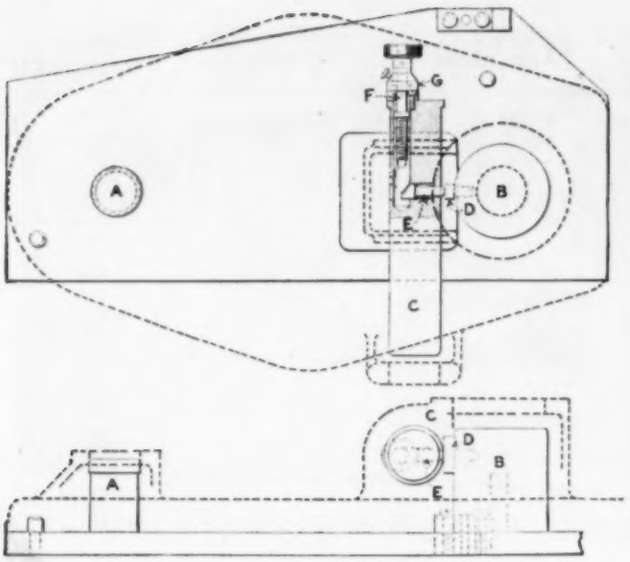


FIG. 9. INSPECTION GAGE FOR FRONT COVER

against the side of the casting as at *E*, hold it against side movement, while the clamp at *A* effectually overcomes any tendency for it to lift out of the fixture.

The boring, reaming and facing of the cross-shaft hole is accomplished in the fixture shown in Fig. 7. The cover plate is located by means of studs which enter the holes *A* and *B*. The bearings *C* and *D* are then bored and faced, the boring bar being guided both top and bottom as can be seen. Right- and left-hand facing cutters *E* and *F* face the ends of the center bearing. A finished cover is shown on the floor.

The drilling of the screw holes around the cross-shaft hole is accomplished on the fixture shown in Fig. 8, the cover itself being removed to show the fixture more clearly. The cover is located and held by studs at *A* and *B* as in Fig. 7. The extension *C* projects inside the casting and locates the plate *D* which carries the four drill bushings. This plate is pushed down through the hole in the front cover after it is in place and guides the drill. There are also four bushings in the extension *C* which guide the drill down to the lower surface and insure the holes in both flanges being in line.

The gage for determining the relations of the holes in the front cover is shown in Fig. 9, the outline of the cover being shown in dotted lines. The upper hole of the cover fits over the stud *A* and the large hole over the stud *B*. The plug *C* is then slipped through the crosshole, to determine its relation to the hole *B*. The piece *D* is inserted in the plug *B* as a measuring point for the plunger *E* which is controlled by the micrometer screw *F*. This device acts, by means of the cone point on *F* and the bevel on *E*, so that the variations can be easily read on the graduated dial at *G*.

Organization and Management of the Small Shop

V. Production Planning and Control—The Necessity and Uses of System—Figuring Shop Capacity—Management of Production—A Simple Method of Cost-Keeping

BY E. W. LEACH

IS THERE a limit to your possibilities? Have you ever said to yourself, "I can do this, but I can't do that, it is impossible"? Or better yet, have you ever seriously asked yourself, "Am I doing all that I can, and is it all my best"? There is a limit to present possibilities of your shop. There is a condition you can reach when your shop will be "running to capacity," and beyond that point you cannot go unless you add more equipment, work longer hours, or devise faster ways of doing things.

But are you running to capacity? Are you doing all that you can with your present equipment? When a shop is not running to capacity something is being wasted. Maybe you have invested in machines which are not kept busy all the time. Maybe you have too many of one kind of machines and not enough of another. Maybe there are times when those machines cannot be kept busy because of lack of materials. Possibly your men themselves are inefficient and are not living up to the requirements of the job. Possibly lack of standard practices results in a lot of scrapped work of certain kinds. Or it may be the sales force is not up to snuff in obtaining sufficient business so that it is good judgment to run to capacity.

There are a hundred and more "maybe's" one could mention that can creep into any business where those in charge do not keep their eyes eternally open to see that they are kept out. But for every "maybe" I have mentioned, and I am sure that for every one you could mention in addition, there is a remedy. And by applying that remedy you will bring your production closer to its maximum. This remedy is to plan your production beforehand, and then control it afterward. That is not merely a remedy for shops that are permitting their production to be governed haphazardly, but it is a preventative against decreased production in shops that are just being organized.

Small shops, it seems, are particularly susceptible to the dangerously expensive practice of "just drifting along," without any system, without any attempt to be methodical and to keep records. Too many small-shop owners say, "Sure I'd like to have a nice cost system and an elaborate method of production control; but I can't afford it." The cost of a system, if it be laid out sensibly and with a view to practicability, should be more than made up a dozen times a year in the savings it effects for you through the information it places at your disposal and through the increased efficiency which it brings into the management of your business. If you are going to look upon the installation of a system as an expense from which there is no return, I cannot hope that this article will be of any value to you whatever. It's something like your advertising—you don't pay for it, the customer doesn't pay for it, it actually *pays for itself*.

If you do not know the capacity of your shop, the time to find it out is *right now*. Maybe you have a small plant from which your shipments are averaging $5,000 a month. Do you know whether you could possibly produce $10,000 worth of goods in a month in that plant? If you don't know, it is very likely you are not realizing all the volume that is yours for the getting.

Or if you find that you cannot possibly produce more than $6,000 worth of goods a month, and yet the increasing demand for them necessitates bringing your production up to $10,000 a month, do you know what to do to raise it to that point? Those are problems which you can solve if your production is properly planned and controlled. I am going to give you a rather unusual definition of production planning and

BILL OF MATERIALS, ECONOMY SKIVER

CASTINGS:

1 Base	2 Feed rolls
1 Frame	1 Crank
1 Top arm	1 Gear guard
2 Gear blanks	1 Leather guide

Cold Rolled Steel Parts:

2 Feed roll pins
1 Blade adjusting screw
1 Hinge pin
1 Spring swivel pin
1 Blade holder
1 Crank handle
1 Blade adjuster nut
1 Short sleeve
1 Long sleeve
1 Upper feed roll shaft
1 Lower feed roll shaft
1 Leather guide screw
1 End washer
1 Blade adjuster bearing
1 Knurled nut
1 Outside blade hanger

Set Screws, Etc.:

2 $\frac{3}{16}$ x $\frac{1}{4}$-in. hdls. cup point set screws
1 $\frac{3}{16}$ x $\frac{1}{4}$-in. low head cup pt. set screw
1 $\frac{1}{4}$ x $\frac{1}{4}$-in. low head cup pt. set screw
1 $\frac{5}{32}$ x $\frac{3}{8}$-in. rd. head machine screw
4 $\frac{1}{4}$-in. No 10 rd. head blued wood screws
1 $\frac{1}{4}$ x 4$\frac{1}{2}$-in. machine bolt
2 $\frac{3}{16}$ x $\frac{1}{4}$-in. rd. head rivets
1 $\frac{1}{4}$-in. cut washer
1 $\frac{1}{4}$-in. semi-finished hex. jam nut

Special Parts:

1 Blade
1 $\frac{1}{4}$-in. extension spring
1 $\frac{1}{4}$-in. compression spring

TABLE I. FORM FOR "BILL OF MATERIAL"

control. Here's what it means to the small-shop owner:

Knowing just where you are,
Knowing just where you're going, and
Knowing just when you should get there.

Before you can get any production at all in your shop, your men must know exactly how the various jobs are to be done; and that will call for blueprints. If you give a man a job and a blueprint and he makes a mistake, it's clearly "on him." If you gave him the job with only verbal instructions, there are any number of possible alibis he could offer to shift responsibility for a slip-up.

For simplicity of explanation, we will assume that you are making but a single machine or product. For your own information you should have a "Bill of Material" (see Table I) for this machine. This will show all the castings, the steel parts, the screws and bolts, and any other parts, and give the number used on each machine. From this bill of material you can figure your "Requirements per 100," (Table II). This is a good quantity to use as a unit, and knowing your various requirements for that number of machines, if you wish to put through 500 at a time you will know how many castings you must order from the foundry, how many feet of each size and kind of steel you will need, and exactly what quantities of other items.

Your purchase orders should always be written. Telephoned orders should always be confirmed later by a written one. Whether you have your own printed forms or whether you buy a ten-cent blank order book is not so important as the fact that you are putting things down in black and white, eliminating the possibility of duplication and making it easy to place responsibility for mistakes in deliveries. After your materials have been ordered in the proper quantities and you know they will be on hand when needed, your next job is to lay out the work for your men. First you must make a record of the different operations to be performed on each piece, and the machine on which each operation should be performed. In laying out the forms which you will use for orders, requisitions, etc., a good rule to follow is this: do not have any form or any single item on a form that does not serve a real purpose, or that is not actually used. If you will bear that in mind your system will be simple, it will be inexpensive from the standpoints of the printing cost and the time it takes to keep it, and yet it will provide you with the desired information. Any of the illustrations to this article are, at best, only suggestive, for no one can pretend to lay out record forms without knowing the individual problems of the shop where they will be used.

Keeping Track of Production

One form that you should have, even though you may not have as many as half a dozen men on your payroll, is a "Factory Order Card." The one shown in Fig. 1 accomplishes more than one purpose. It helps you to make out the job cards which you will give out to the men as their authority to do certain work. It serves as a progress report to show at any time just how nearly completed the work on a certain batch of parts may be. And it also provides a permanent cost record, giving you on one sheet the costs of each operation and the total cost of the finished piece. One of these cards will be made out for each lot of similar castings that you order machined, one for each batch

MATERIAL REQUIREMENTS FOR
100 ECONOMY SKIVERS

Castings:

100 Bases
100 Frames
100 Top arms
200 Gear blanks
200 Feed rolls
100 Cranks
100 Gear guards
100 Leather guides

Cold rolled steel:

45 ft. $\frac{3}{16}$-in round
63 ft. $\frac{1}{4}$-in. round
40 ft. $\frac{5}{16}$-in. round
12 ft. $\frac{3}{8}$-in. round
102 ft. $\frac{7}{16}$-in. round
4 ft. $\frac{1}{2}$ round
30 ft. $\frac{1}{8}$ x $\frac{1}{2}$-in. flat

Set Screws, Etc.:

200 $\frac{3}{16}$ x $\frac{1}{4}$-in. hdls. cup pt. set screws
100 $\frac{3}{16}$ x $\frac{1}{4}$-in. low hd. cup pt. set screws
100 $\frac{1}{4}$ x $\frac{1}{4}$-in. low hd. cup pt. set screws
100 $\frac{5}{32}$ x $\frac{3}{8}$-in. rd. head machine screws
400 $\frac{1}{4}$-in No. 10 rd. head blued wood screws
100 $\frac{1}{4}$ x 4$\frac{1}{2}$-in. machine bolts
200 $\frac{3}{16}$ x $\frac{1}{4}$-in. rd. head rivets
100 $\frac{1}{4}$-in. cut washers
100 $\frac{1}{4}$-in. semi-fin. hex. jam nuts

Special Parts:

100 Blades
100 $\frac{1}{4}$-in. extension springs
100 $\frac{1}{4}$-in compression springs

TABLE II. FORM FOR "REQUIREMENTS PER 100"

of steel or other kind of parts, one for each subassembly, and one for the main assembly.

If you want 500 machines started through at one time, you will make out a factory order card for each

separate part, noting on each card the name of the part, its number, the quantity, and listing the numbers of the job cards issued under that order. If there are not too many orders going through the shop at once, it is a good plan to keep the cards on hooks on the wall where each one can easily be seen. Then they are in plain sight all the time and any orders which get behind will be quickly noticed. This method will also help to eliminate the danger of orders being overlooked and forgotten as might be the case if you merely kept the order cards in a drawer or a file. For convenience you can arrange all the cards pertaining to one machine in one row, or you may prefer to arrange them according to part numbers without regard to machines.

For each factory order card you will make out as many "Job Cards" as there are operations on the part specified. The job card shown (Fig. 2) is another "combination card," that performs more than one function and is therefore especially adapted to small-shop use. This card is an instruction card for the machinist or assemblyman telling him what is to be done, and it also takes the place of a time-card if you have not enough men to warrant buying a time clock.

FACTORY ORDER CARD — ORDER No. 271

QUANTITY 350 — NAME OF PART Feed Rolls — PART No. 8-5

OP.	JOB CARD	STARTED	FINISHED	COST EA.	OP.	JOB CARD	STARTED	FINISHED	COST EA.
1	566	3-6	3-6	.0076					
2	567	3-6	3-7	.0143					
3	568	3-7	3-9	.0248					
4	569								
5	570								
6	571								

Date of issue Finished 3/19/21
By C. Rue
Note: Overhead is figured on labor cost only

Labor cost
Material cost
Overhead
Total cost each

FIG. 1. SAMPLE FORM FOR ORDER CARD

JOB CARD — NUMBER 568 — DATE 3-4-21

QUANTITY 350 — NAME OF PART Feed Rolls — PART No. 8 5

No. OF OPERATION 3 — NAME OF OPERATION Turn to diameter — ORDER CARD 271

DATE	START	STOP	HOURS	START	STOP	HOURS	TOTAL
3-7				3:00	5:00	2	2
3-8	8:00	12:00	4	1:00	5:00	4	8
3-9	8:00	12:00	4	1:00	1:30	½	8½

Machine scrap — Foundry scrap — Hours 14½ — Rate .60¢
Workman Bughes — Total job cost 8.70 — Cost per piece .0248

FIG. 2. SAMPLE JOB CARD

USING A "PRODUCTION BOARD"

Job cards should be sorted out according to the machine on which the operation will be performed. A "production board" can be made with a nail for each machine in the shop, and after the job cards are made out and listed on the factory order cards, they are hung on the proper nails to await their turn. With a definite quantity of work going through the shop you can tell by looking at the milling-machine peg just how many jobs are stacked up for that machine, and by referring to your factory order cards you can arrange the milling-machine jobs in proper sequence so that the most important work will be given first consideration. When a man comes to you for a job you will look at the job cards for his machine and give him the one for the job that should be taken care of first, together with the proper blueprint. The card at this time shows the date and number, the number of the order card under which it was issued, the name and number of the workman, the name and number of the part, the quantity to be machined, and the name and number of the operation.

The workman marks down his time on the job and makes note of any parts that are scrapped, indicating whether they are scrapped through fault of himself or some other workman, or whether the castings as they came from the foundry were defective. This information will be necessary so that you can get proper credit from the foundry for defective castings. The workman also changes the quantity specified if necessary, so that it agrees with the number of parts that he finishes and turns in as O. K. When the job is completed he turns in his card and blueprint. The factory order card should then be checked showing the date this operation was completed. From the time consumed on the job, and knowing the workman's rate per hour, you can figure the cost per piece for that operation. That figure should be put on both the job card and the factory order card, and the job card filed away for future reference.

The cost per piece should be figured promptly, because a job card is much like a street-car transfer—it's no good after it gets old. If the time on a job is a lot more than the average past performance for that job, there will be nothing accomplished by trying a month later to learn the reason for the difference. That sort of information must be gotten without delay if it is to be used effectively to prevent recurrences of unjustified costs.

A unit of measure that will be valuable in determining production and capacity is the "Man-Hours per 100," and here's how it is derived and how you can use it: On the job card illustrated, it took 14½ hr. to turn 350 rolls. Dividing 14½ × 100 by 350 we get 4.1, and that is the "Man-Hours per 100"; that is, it is the number of hours in which one man would perform that operation on 100 pieces.

DETERMINING CAPACITY OF EQUIPMENT

If you wish to learn how nearly you are running your shop to capacity, or just what the capacity of your shop is and how it can be intelligently increased, figure the man-hours per 100 for every operation on every part, and then sort out these figures so that you know the man-hours per 100 machines for each machine tool in the shop.

We'll assume that your totals work out something like Table III.

Machine Tool	Man Hours per 100
Turret lathe	53
Engine lathe	76
Milling machine	92
Drill press	65
Bench drill press	60
Grinding machine	34
Assembly bench	100
Total hours	480

This means theoretically that one man could make 100 machines complete in 480 hours. Now, then, supposing you are shipping 200 of those machines a month. They net you $12 each, so that your sales or shipments

are $2400 a month. You plan to put out some extensive advertising and you believe this will increase the demand for that machine so that you will want to produce 300 a month. Let's see how it will work out:

The milling machine is worked harder than any other in the shop. It works 92 hr. for every 100 machines you produce. That means that if you wished to make 300 machines a month the miller would have to work 276 hr. If you work your shop 48 hr. a week, there is nearly six weeks' work for the milling machine alone. Even by increasing the day to 10 hr. you would still fall short of your schedule. Four weeks of 48 hr. each total 192 hr., and according to your present time records, you could do the milling operations on 209 machines in that time.

Under present arrangements, therefore, 209 machines is your monthly capacity. It is plain that the milling machine must have some relief, so you study your milling work and find there is a great deal of it that could be done on a small shaper. The thing to do, it would seem, is to install a shaper. That will certainly be much less expensive than buying another miller, and it will also enable you to do in your own shop some of the jig work you had been sending outside. After the shaper is installed, you switch some of the boring that you had been doing on the engine lathe over to the turret and your machine-hours per 100 now figures as shown in Table IV.

Machine Tool	Man Hours per 100
Turret lathe	61
Engine lathe	64
Milling machine	44
Shaper	40
Drill press	65
Bench drill press	60
Grinding machine	34
Assembly bench	100
Total hours	468

Now we're most interested in the drill press. In turning out 300 machines there will be 195 hr. of work for the big drill press. Four 48-hr. weeks total 192 hr., and we can very probably find some way to cut our time down 3 hr. and bring it within the limit.

The turret lathe will be busy 183 hr., or 95 per cent of the time. The engine lathe will be busy 192 hr., or all of the time. The milling machine will be busy 132 hr., or 69 per cent of the time. The shaper will be busy 120 hr., or 63 per cent of the time. The bench drill press will be busy 180 hr., or 94 per cent of the time. The grinding machine will be busy 102 hr., or 53 per cent of the time. One man on the assembly bench would be kept busy all the time and another man would be kept busy 108 hr., or 56 per cent of the time. This would necessitate a man on each of the lathes; a man on the miller and one on the shaper (as jig and fixture work would probably take up part of their time), two men at the two drill presses, one man at the bench all the time and one man taking care of the grinding and the balance of the assembly work. Adding another man to take care of all painting, packing and shipping would give you a force of nine men. Figuring an average wage of 60 cents an hour, your payroll (not including yourself) would be $259.20 a week, or $1,036.80 a month of four weeks.

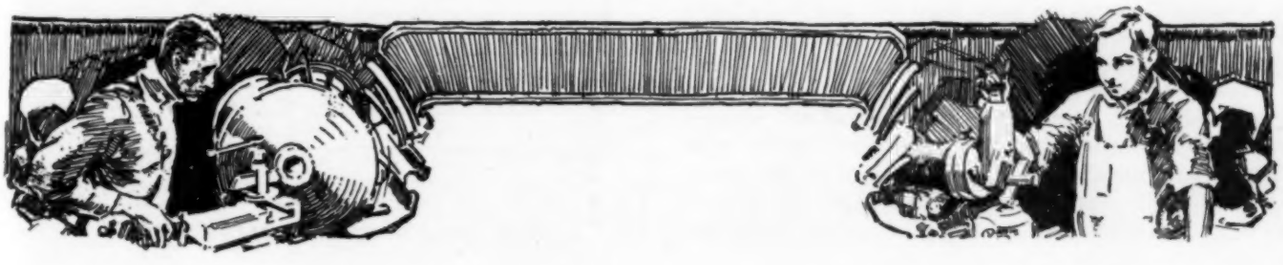
If, in that time you had produced 300 machines, it would seem that your labor cost per machine amounts to $3.46. But according to our schedule there are only 468 man-hours of labor per 100 machines. At 60 cents an hour this would total $280.80, so that really your labor cost on each machine is only $2.81, and the difference between that figure has been spent partly in working on parts for more machines and partly in indirect or non-productive labor such as machining jigs or painting and shipping.

Possibly there is not the slightest similarity between the figures and machines and times given in my suggested problem and those in your shop. But it is the thought behind the thing that I am interested in having you get.

I have told you how one small shop plans and controls its production. It makes several different machines. Some of them sell for $5, some for $200; and so there are variations and elaborations that have been necessary from time to time, but the principles are those which have been explained here. It looks as easy as falling off a log, doesn't it? Well, it really isn't quite as simple as that because it's the unexpected that happens sometimes and throws the best of plans out of gear. No system will ever work out in actual practice exactly as it was arranged on paper. No system is "foolproof," and so you must not look forward to the time when you can come down to the plant at ten o'clock in the morning and leave at about three in the afternoon, trusting to your systematic control of work to insure things running smoothly during your absence. A machine may break down, a workman may quit, the foundry may fall down on deliveries—you know the long list of such possibilities as well as I. And all of those incidents hold up your production and delay the service on shipments.

Without a systematic control of production, such emergencies leave you hopelessly "in the soup." But if you have a clean cut system of record keeping, you know just how serious each delay is, how seriously it interferes with your plans, and what temporary or permanent measures you must take to get back into schedule as quickly as possible. Long, long ago we were taught that "Order is Heaven's first law." Keep that thought before you in managing your small shop, and you will save yourself unmeasurable grief and make the shop a pleasant and businesslike place for all.

It will be a big satisfaction, but more than that, it will actually pay you many times over to plan and control your production so that at all times you know just where you're at, just where you're going, and just when you ought to get there.



Ideas From Practical Men

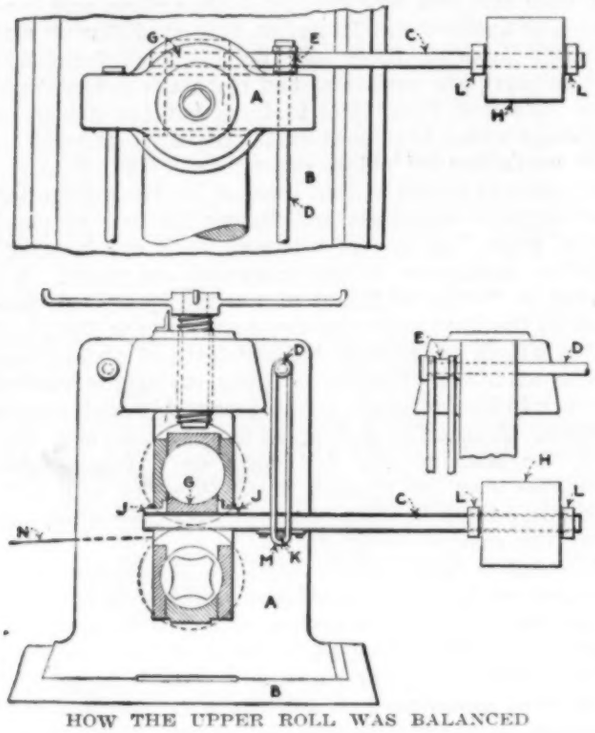
Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

A Rather Unusual Job for a Sheet Rolling Mill

BY C. F. GEORGE

Illustrated herewith is an arrangement for rolling ¼-in. plates from a billet 2 in. in thickness. To do this work on the ordinary sheet mill would have been almost impossible without some such device as shown.

There were two main points that presented themselves: First the lifting of the top roll so as to allow



HOW THE UPPER ROLL WAS BALANCED

the billet to pass under it and second to counterbalance the top roll so that it would not drop and injure either itself or the bottom roll after the billet had passed through the mill.

The plan decided upon was to balance the top roll as much as possible and this was accomplished in the following manner: The illustration shows an end view of one of the roll housings *A* which is held securely to the baseplate *B*. The plan view is only a half one, the other half being exactly the same as that shown. Two 5 x 3-in. girders *C* carry the main load and are hung from the back staybolt *D* by forged steel links *E*, two for each girder. Spacer collars *F* were provided between the links *E* so that the staybolt could be tightened up in the usual way. Secured to the ends of the girders were the cast-iron bearings *G* which had to fit the neck of the roll and were held in place by means of the straps *J*. Two 1,500-lb. coupling boxes *H* provided the desired balance at the other ends of the girders and were prevented from coming off by means of the collars L. The girders *C* were fulcrumed at *K*.

The billet was fed through the rolls from the platform *N* and the screws were adjusted at each pass of the billet until the proper thickness was obtained. I may say that over 100 tons of this steel was successfully rolled in this way but it was found advisable after bringing the billets to half their thickness to reheat them to roll to the finished thickness.

Tool for Shortening Valve Stems

BY JOHN LANG

The writer recently had a hurry call to shorten, by about ⅛ in. the stems of a number of needle valves for carburetors. These valves were all finished and the assemblers were waiting for them on a rush order.

The stems were about 3½ in. long and ⅛ in. in diameter with a reversed cone on one end that must not be marred.

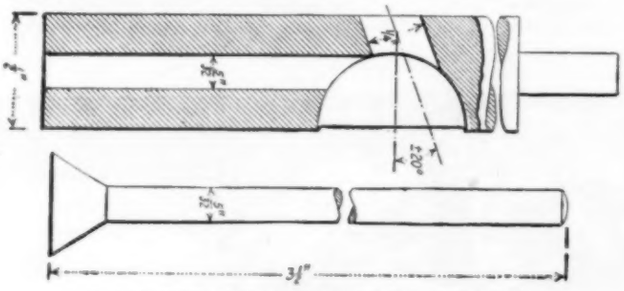
To do the work in the bench lathe without a special chuck would take too long as a wire chuck would have to be taken out on each one; so I took a piece of ½-in. drill rod, drilled a crosshole in it as shown in the sketch at an angle of about 20 deg., chucked it in the bench lathe and drilled a ⅛-in. longitudinal hole to meet the crosshole.

I then roughly ground out a groove as at *A*; grinding to the center and a little way round on each side—altogether a little more than half of the rod. The other end I reduced to go in a drill chuck and then hardened to below the groove.

Holding the stems in a pair of pliers and the tool in a drill press chuck, I inserted the end of the stem in the ⅛-in. hole and pressed down about as hard as if I were drilling a No. 30 hole.

The whole lot of stems were shortened in about 5 seconds each, with a nice radius on the end. No filing of any kind was done on the tool, which took about 15 minutes to make.

[The line cut accompanying this article was unfortunately used in error in last week's issue with an article on drawing gear teeth rapidly. This article will be republished with its proper cut in an early issue.]

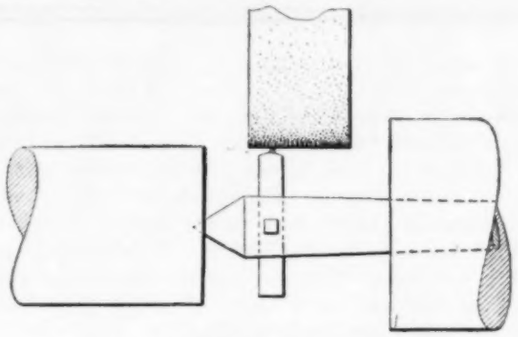


TOOL FOR SHORTENING VALVE STEMS

Method of Truing Grinding Wheel

By Robert J. Thorn

The quickest and most convenient way I have ever found to true a grinding wheel is to provide a tailstock center a little longer than usual, with a transverse hole



METHOD OF HOLDING THE DIAMOND

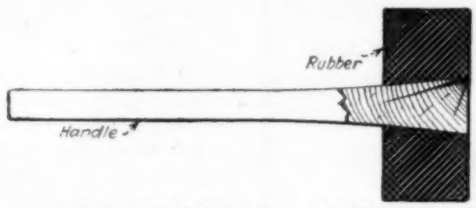
and setscrew as shown. The holder with the diamond is adjusted through the center with the point about even with or a little back of the surface of the work. To true the wheel it is only necessary to lock the center and with a very short movement of the crossfeed the wheel is brought to the diamond.

Handle for a Rubber Mallet

By W. F. Schaphorst

Rubber mallets or hammers are very useful for hammering delicate metal parts that must not be scratched or battered. Every mechanic should have a rubber hammer handy.

One of the objections to the ordinary rubber hammer, however, is that it easily "flies off the handle." The rubber hammer cannot be wedged like a metal hammer



HOW THE HANDLE IS APPLIED

because the wedges simply stretch the head so that it is liable to fly off at any time.

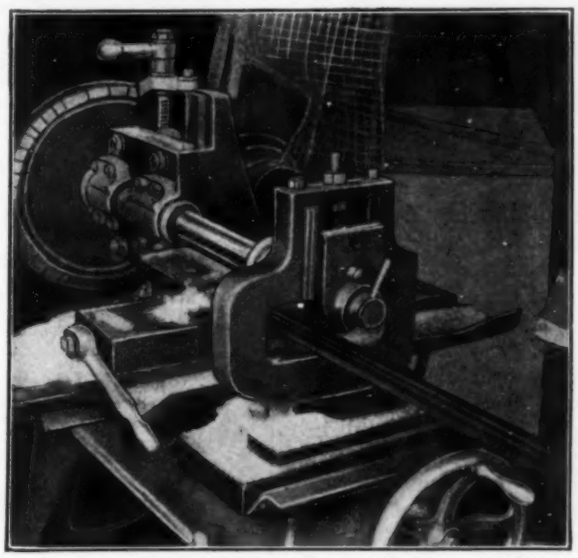
To overcome this objection a friend of mine has hit upon the method of using a handle similar to that used in an earth pick. The handle is large at the head end and is inserted in the head by slipping the handle end in first. In this way the danger of flying off is overcome. The sketch herewith shows how it is accomplished.

Handling Long Bars on a Lincoln Milling Machine

By Donald A. Hampson

There are two or more ways to do every job and what is good practice in one shop is poor in another. Consider parts made from drawn steel and brass bars. Most shops cut them off in saws or in automatic screw machines. The subsequent operations are performed in semi-automatic milling or drilling machines. Where the work is milling only, the method of forging and cutting off complete at one operation has many advantages and would doubtless be given wider consideration but for the fact that the conventional form of manufacturing milling machines has a tailstock or outboard bearing right in the way of the bars, necessitating a transfer of work to other processes.

A milling machine equipped with a special tailstock is shown in the illustration. Three rectangular drawn steel bars constitute a load. A special vise holds the bars which are cut off and notched close to the tailstock by a set of three cutters. The shop turns out a variety of products made from rectangular, hex, round and square bars and almost without exception the work is cut off and formed at one time. Reference to the tailstock will show that it is long in front, providing for safe working space when the table is run out for loading. Its stiffness has been proved by some of the



MILLING MACHINE WITH SPECIAL TAILSTOCK

toolings which have gangs of twenty cutters and cutting sections of two square inches in steel.

The cutting time on a combined cut-off-and-form-job of this kind is no more than with forming only, but even if the cutting time was much more, it might easily be offset by avoiding second operation work, as has been demonstrated in other forms of shop practice. If a great deal of this work is to be done, it can be put in a department by itself, nesting the machines and placing them on a 20-deg. angle, as in automatic screw machine practice.

An Inexpensive Counterbore

By George H. Barker

The accompanying illustration shows a counterbore made from an old high-speed drill.

We have found this to be a very economical way to secure counterbores for our work as it is easy for the

COUNTERBORE MADE FROM OLD DRILL

toolroom to make them from discarded drills. A large variety of sizes, both as to outside diameter and the pilot, can be maintained at a very small cost.

IN THIS ISSUE

THIS issue opens with an article by the metallurgist of the Duff Manufacturing Co., telling of the effect of heat treatment on steel castings and drop forgings. The practical value of this story is indicated by the fact that it is based on the results of an exhaustive series of tests on both castings and forgings. The author tells of the care used in getting truly comparable specimens and in the accurate control to test conditions. Micro-photographs are used to illustrate the changes in structure evident at the various stages of heat-treatment and also by diagrams comparing tensile strengths, area reductions and the results of impact tests. There is also something on chemical specifications.

Another article which is more or less allied in scope to the one we have just discussed is that on the characteristics of the average milling cutter, by the metallurgist of the Detroit Twist Drill Co. While the first article deals with more or less general conditions the latter concerns itself more particularly with the steels used in high-speed twist drills and milling cutters. Here again micro-photographs are used to illustrate different structures of various steels. The article goes on to tell of the treatment of high-speed steel from the ingot stage to final cutter blank in easily understandable language.

Sandwiched between these metallurgical articles are installments of two of our most important series, section IV of Professor McCabe's "Economics of Production" and section XXI of W. R. Basset's "Modern Production Methods." The subject of the economics article in this issue is "Causes of Changes in Demand." If anyone in the metal trades has not been affected by changes in demand in the last year or so we should be very pleased to meet him. It seems to us that he would be the only one who would not have a keen interest in the causes of changes that have been so disastrous to many. Professor McCabe's exposition of this topic is as clear and concise as the way in which he has handled the preceding ones. We are convinced everyone who reads it will have something to think about.

In this day and generation the graphic chart has most certainly come into its own. Its uses are manifold and unfortunately its abuses are too numerous. Rightly used, it is undoubtedly a most efficient tool; wrongly used it is a great consumer of time and energy. Mr. Basset in this installment of "Modern Production Methods" shows both good charts and bad charts and gives valuable hints as to when to use charts and when not to. Sales charts, machine-hour charts, payroll charts, expense charts, and others are all included and described in considerable detail. This section makes a fitting ending to this division of the major subject. It will be followed in a short time by three articles on motion study and rate setting.

On page 428, our New England editor tells in some detail of the methods used by the Pratt & Whitney Co., in large scale production of adjustable limit snap gages. The job is naturally one where extreme accuracy is absolutely essential and one which lends itself to the application of jigs and fixtures. The article is well worth reading.

Next comes the conclusion of part XIX of the Dowd & Curtis series "Tool Engineering." It continues the subject of methods of, and fixtures for broaching of all kinds.

Then on page 436 there is a short article by Fred H. Colvin on the machining of the front cover and crankcase lower half of the Peerless automobile motor. As usual with his work the story is told principally in the pictures. (You would never guess it but he owns up to being an ardent movie fan.) Following Mr. Colvin's article we have the fifth installment of Leach's "Organization and Management of the Small Shop." Here the author tells of planning and control of production in the small shop, and takes up some simple ways of keeping time, cost and production records. Those who have followed Mr. Basset's articles all the way through will no doubt be interested in comparing the methods of the big shop with those of the little one, as told by Mr. Leach.

There are not so many practical letters in this issue but the ones shown are particularly good we think. The letters will be found in about the usual position, the page number this week being 442.

If they do not measure up to your standards why not send us in what you consider to be good ones? You may not know that we are only too glad to get them and to pay for them in real money.

Coming Features

Complete Articles for the next issue:

The Rolls-Royce Crankshaft—Fred H. Colvin

Piston Work in Motor Repairing—Special Correspondence

Making the Peerless Ring Gear, Spider and Gears—Fred H. Colvin

Series Articles for the next issue:

Economics of Production (V)—Prof. D. A. McCabe

Tools Used in the Manufacture of the P. & W. Adjustable Limit Snap Gage (II)—Ellsworth Sheldon

Metal Cutting Tools (XV)—A. L. DeLeeuw

Tool Engineering (the twentieth part)—A. A. Dowd and F. W. Curtis

Manufacturing with Special Machines vs. Standard Equipment — Col. F. Jenks and H. M. Christopherson.

EDITORIALS

Are We Overvaluing Statistics?

IN A RECENT address, D. G. Wills, chairman of the Federal Reserve Bank of Cleveland had this to say:

"Accurate data intelligently arranged is so far ahead of hunches, guesswork, general results and rule-of-thumb that it is as electricity to candle light. Nevertheless, its use can be overdone and is being overdone. Charts and barometers are fine, but there are two subjects that cannot be charted; they are God Almighty and human nature, and both cut quite a figure. Also it should be remarked that it is a person of rare qualifications that can analyze and make proper deductions from statistics.

"It is my judgment that a lot of us are getting our trousers shiny sitting at our desks pouring over statistics, department reports, etc., who could spend our time to better advantage learning the people in our organizations and getting a more intimate knowledge of the viewpoint of those with whom we do business."

Mr. Wills is quite right. Statistics of business are of considerable value but they have their limitations. They are no more accurate than the source from which they are derived and unfortunately there is both inaccuracy and incompleteness in many of the sources.

In addition there are many of us who do not hold with the doctrine of fatalism as applied to business. When we get to the point where we are convinced that man has no control over his business destiny it will be time to step aside and let a more progressive race succeed us. Thank Heaven, we are still far from that stage.

The Human Side of Wage Cutting

THE efforts of some managers to keep their organizations together have brought out many interesting characteristics in the personnel. This is particularly true of the smaller shops where the men and management are more closely related and get together in a more man-to-man fashion than is often possible in large institutions.

In one case where the contacts have always been personal and intimate, the manager held a shop meeting some time ago and laid his cards on the table, face up. He told the men frankly he was up against it for ready cash; that they had good assets, good customers and good prospects when business came back. But the great job then was to be sure of getting the payroll together every week. He hadn't cut wages although he had slashed his own salary to the point where it cut out all luxuries.

He pointed out that some of the men were getting more than others, because they earned more, but that it cost the men with the lower wage just as much to live as the other—sometimes more, if he had a larger family, as was often the case. He then put it up to the men as to whether the higher rate men should stand a larger cut. And here's where the human interest comes in.

The high-priced men voted unanimously to take a cut that brought them down to the low level, the same as with the lower grade men. The good feeling which existed in the shop brought out the best that was in them and the feeling of brotherhood was stronger than selfish desire for personal advantage. And the gratifying part to the manager was that not a word was said about restoring the higher rates to the best men when business came back. The men's knowledge of the manager's fairness made it unnecessary—and they all knew it. Could a manager have a more striking testimonial or recommendation?

Such an arrangement may not bear the scrutiny of an analytical and cold-blooded economist. He could probably point out its weakness from several angles and deplore the abandonment of special reward for individual effort. But most of us will appreciate the human sympathy and the desire to help the other fellow out of a tight place. And the manager who can inspire such confidence in his men has done much to prevent misunderstandings and delays in the days to come.

One Phase of the Airplane Industry

THE successful development of any new industry depends upon having the factors which enter into it on a substantial basis. One of the phases of successful airplane development is that of securing adequate and proper instruments of navigation and other elements which enter into flight under all conditions. Unless such an industry is developed along with aircraft itself, the usefulness of aircraft will suffer.

All recognize the necessity for, and the advantages of, competitive bidding for Government contracts. But as with private enterprise, all circumstances should be carefully considered in awarding contracts. In these days of business dullness many plants are very naturally groping after orders in lines quite apart from their regular field. This is perfectly proper and shows laudable enterprise. But when such competition brings out bids which are so low as to prevent a living profit another factor must be considered.

There are a few firms which are devoting all their time to the development of this field. Others who are now bidding on this work are simply trying to fill in until business in their regular line resumes somewhat normal proportions. Then this source of supply will be closed to aircraft development.

If bids enough are awarded to firms of this sort, the few who have devoted their time, energy and capital in building up a pioneer industry, may be forced out of business. Then, when the airplane development begins in earnest, it will be handicapped by this loss.

Contracts should not be awarded to anyone at exorbitant figures, but neither should unfair bids be accepted to save a few dollars when it endangers the future. Quality of work, reliability of the product and last but not least, the need of maintaining a reliable and permanent source of supply, should be considered, as well as price. As an infant industry it needs consideration, not for itself but for its effect on the development of aircraft in general.

Shop Equipment News

Onsrud Pneumatic Turbine-Type Grinder

The Onsrud Machine Works, Inc., 3908 Palmer St., Chicago, Ill., is placing on the market a high-speed motor driven by compressed air and intended especially for driving grinding wheels. It is said that the motor attains a speed as high as 30,000 r.p.m., the speed of operation being controlled by means of a valve placed

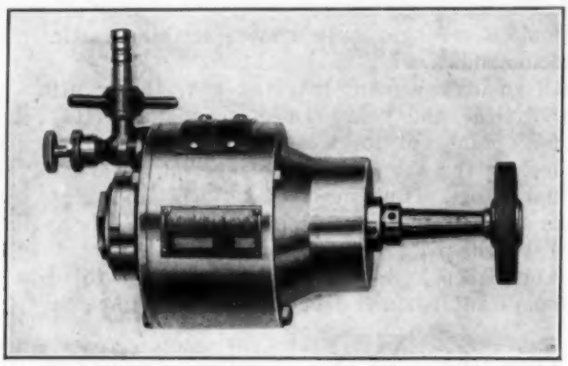


FIG. 1. ONSRUD PNEUMATIC TURBINE GRINDER

at the entrance of the air to the housing. Although the complete unit weighs only 5½ lb., it is said to be capable of producing ¼ hp., giving ample power for the driving of the small wheels for which it is intended.

The turbine unit, shown in Fig. 1, can be easily held in the hand and operated the same as any portable grinder. However, it is especially intended for attachment to machine tools, and is then held by means of special clamps fastening around the front end of the housing. A heavy shank is provided for holding the grinder on the toolpost of a lathe. A stand for mounting the device on a bench is also made, a toolrest being provided on the stand so that work requiring light grinding, such as tools and cutters, can be easily held in position. For the purpose of grinding center points, a special fixture is provided for holding the grinder spindle at an angle of 30 deg. with the spindle of the headstock of a lathe, so that the proper angle can be ground on the points. This fixture is provided with detachable plugs for insertion into the spindle of the tailstock of the lathe, the use of interchangeable plugs permitting of grinding the centers on either large or small lathes. The grinder can also be mounted on a special bar to permit its use for deep internal grinding where the bore is 5½ in. or larger in diameter, this device being shown in Fig. 2.

The motor of the device is of the three-stage turbine type, operating on the impulse-reaction principle. Stationary vanes between the rotors reverse the direction of motion of the air, so that the impulse on the rotors is in the same direction in each case. The rotors consist of bronze disks with the blades formed in them by milling out the buckets from the solid metal. Thus, sufficient strength is given to the blades, and lightness is also obtained. The rotors are mounted on a heavy spindle, the whole unit being balanced by a special process. The unit makes contact with the other members of the machine only at the ball bearings, which consist of two open-type Norma precision ball bearings of large size, and which are provided with equalizing adjustment and a locknut to give radial and lateral rigidity. There is, thus, no end-play on the spindle, so that grinding can be done with the side, as well as the face of the wheel. It is stated that the balancing is so perfect that vibration is practically eliminated, and that it is scarcely perceptible even though the grinder be held in the hand when running at top speed.

One of the chief advantages of this type of motor is the fact that it operates cold, the ball bearings being kept cool by the passing of the exhaust air over them. The air is then directed from within the turbine casing on to the grinding wheel, so as to blow away dust and grit and aiding in preventing the wheel from becoming loaded. Thus, it is not possible for grit from the wheel to become lodged in the bearings, as it is constantly blown away from the one opening in the housing. In the case of overloading or stalling the spindle, no harm will be done to the motor, as would occur in the case of an electric motor.

The arbors carrying the driving wheels are interchangeable in the spindle of the turbine. Thus, it is possible to leave the abrasive wheel on the arbor with which it is used, and merely change the complete arbor assembly when it is desired to change wheels. Large

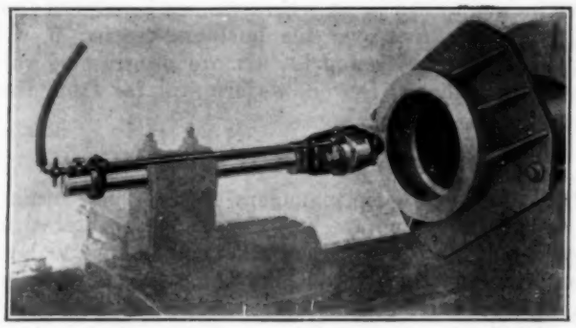


FIG. 2. ONSRUD GRINDER MOUNTED FOR INTERNAL WORK IN DEEP BORES

and small internal arbors, as well as the standard arbor illustrated herewith, can be furnished; and also chucks for holding either cylinders or sticks. The casing of the grinder is made of aluminum, although steel liners are used over the bearings. Lubrication is provided by oil retainers adjacent to both ball bearings.

The grinder is said to require but 10 to 12 cu.ft. of free air per minute at a pressure of 70 to 100 lb. per square inch, although heavier pressures may be used for extremely heavy grinding. The principal feature to which the maker calls attention is the speed of the machine, thus making it possible to eliminate all gearing and such mechanism. The unit is very flexible, because of the fact that the speedy changing of the arbor enables the use of the device for such jobs as buffing as well as grinding, and also because the grinder may be quickly mounted in any of the different styles of fixtures provided for it.

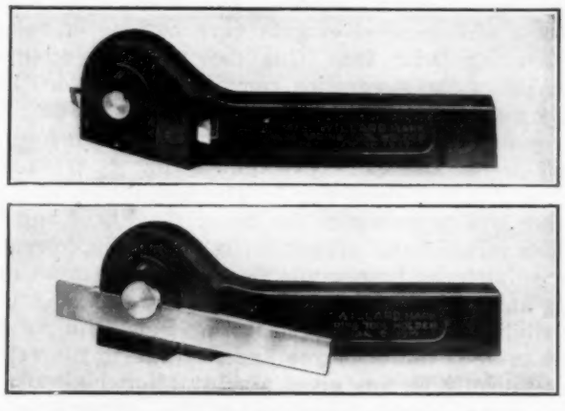
Willard Spring Toolholders

The Willard Tool Co., Inc., 105 East Main St., Stratford, Conn., has recently placed on the market the type of spring toolholder shown in the accompanying illustrations. The holder is made of drop-forged steel, and is hardened to a spring temper. It will be noted that the "goose-neck" is formed by means of a saw-cut through the body of the shank. It is stated that the construction of the toolholder causes the tool to yield or recede in a practically straight line from the work, without causing chatter marks, or endangering the tool when a heavy cut is being taken in tough material.

The device is made in several styles and sizes. At the top of the illustration is shown the regular form of threading and forming toolholder having a right-hand offset. It is said that the tool can work very close to a shoulder, and that it is adaptable both to threading and to the holding of forming tools. The toolbit is carried in a square broached hole, and a non-binding clamping device operated from the side is employed to hold it in place. The action of this clamping device is said to be very rapid and positive. The holder is made in sizes, the No. 3-B holder carrying a toolbit $\frac{1}{4}$ in. square and being $\frac{1}{2}$ x 1 x 6$\frac{1}{2}$ in. in size, while the No. 4-B carries a bit $\frac{5}{16}$ in. square and is $\frac{1}{2}$ x 1$\frac{1}{8}$ x 6$\frac{3}{4}$ in. in size.

At the bottom of the accompanying illustration is shown the cutting-off toolholder of the right-hand offset type. The blade used is beveled on both sides and is clamped in position in the spring end of the holder by means of a special clamping device operated from the side. The blade is provided with clearance in the slot through which it slides on the body of the holder, so that it is free to move somewhat, as the action of it on the work demands. It is claimed that the tool is capable of taking very heavy cuts when supported in this way. The holder is made in two sizes, the No. 3-D holding a cutter $\frac{3}{8}$ x $\frac{1}{2}$ x 4$\frac{1}{2}$ in. in size and being $\frac{1}{2}$ x 1 x 6$\frac{1}{2}$ in. over all, and the No. 4-D being $\frac{1}{2}$ x 1$\frac{1}{8}$ x 6$\frac{3}{4}$ in. in size and holding a cutting tool $\frac{1}{2}$ x $\frac{5}{8}$ x 5$\frac{1}{2}$ in. in size.

The cutting-off tool is also made in a right-hand straight style, particularly for use on automatic screw machines. The back end of the blade lies in a shank which provides plenty of clearances, so that the tool can tilt when necessary. The device is made in three

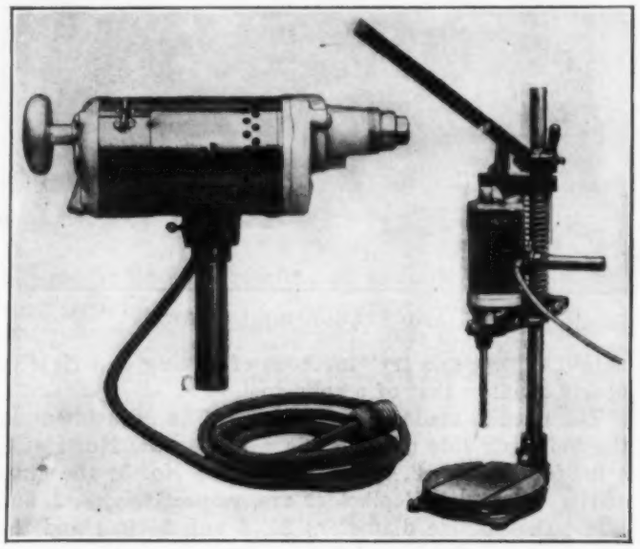


WILLARD SPRING TOOLHOLDERS

sizes, the No. 2-C holding a cutter $\frac{3}{8}$ x $\frac{1}{2}$ x 4$\frac{1}{2}$ in., the No. 3-C and 3-CX a cutter $\frac{1}{2}$ x $\frac{5}{8}$ x 5$\frac{1}{2}$ in., the 3-CX being made somewhat heavier than the 3-C.

Electro-Magnetic Portable Electric Drill

The Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill., is placing on the market the $\frac{1}{2}$-in. portable electric drill shown in the illustration. The tool is intended to meet the requirements of the garage, small



ELECTRO-MAGNETIC PORTABLE DRILL

machine shop and construction or installation gang. The maker states that the price is its chief feature, as it sells for about half as much as the company's standard drill. A simple and rugged stand, shown at the right, makes the tool into a small drill press and increases its usefulness.

The motor is series wound, has a large commutator, square brushes with pigtails, and an aluminum ventilating fan. The gears are high-grade steel, hardened and ground, and all are removable. The spindle shaft is equipped with ball thrust bearings and runs in special bronze bearings.

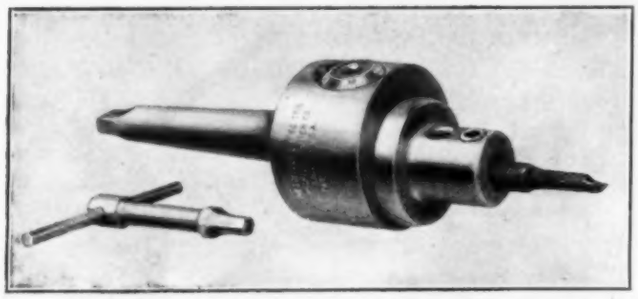
A positive switch gives control of the tool at the handle. All connections are made in the switch box, the cover of which is removable and allows for reconnection or changing lead cords without opening the tool. The commutator may be inspected and the brushes removed simply by taking off a cover plate.

Rickert-Shafer Adjustable Boring Head

The Rickert-Shafer Co., Erie, Pa., has recently placed on the market the adjustable boring head shown in the illustration. The device is provided with two hollow-head setscrews for holding the cutting tool in the hollow shank, and can be furnished with the size and style of taper shank required. A micrometer dial, graduated to thousandths of an inch, is used to vary the eccentricity of the toolholding shank. The dial is connected to a cross-screw in the head, and has a friction device to prevent too free turning. The dial can be set to zero for any setting of the tool, so that it is unnecessary when making further adjustments on a piece of work to remember the previous settings or to calculate the required one.

The tool is said to be adapted to the performing of accurate work at high speed. Rigidity and accuracy are claimed for the holder chiefly because of the type of clamp used, this clamp both locking the toolholder

in the required position and drawing it rigidly against the head and shank. The clamping screw is placed at right-angles to the adjusting screw. The boring head is adapted to use on machine tools performing drilling, boring and turning, the maker claiming for it the elimination of "cut and try" methods of setting and rigidity nearly equal to that of a solid tool.

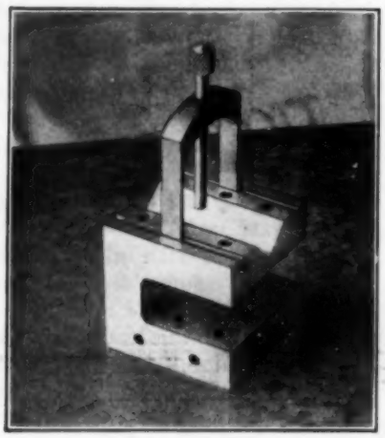


R-S ADJUSTABLE BORING HEAD

The head is made in three sizes. The adjustment of the tool each side of center is ¼ in. for the No. 1 size, ½ in. for the No. 2, and ¾ in. for the No. 3; the sizes of the holes in the toolholder are, respectively, ½, ¾, and 1 in.; the outside diameters 2½, 4 and 5½ in.; and the lengths from the top of the head proper to the bottom of the toolholder 2⅞, 4⅞, and 5⅝ in. A wrench, fitting both the adjusting and the locking screws, is provided.

Toolmaker's Test Block

A square- and test-block for the use of toolmakers in laying out and testing work upon the bench plate, manufactured by the Art Tool Co., 16 Montgomery St., Bridgeport, Conn., has been placed on the market. The block is of carbon steel, hardened and ground square and true in all planes, and the V-groove is accurately located with respect to the sides. It is claimed to be free from error to 0.0001 inch.



TOOLMAKER'S TEST BLOCK

A yoke is furnished with each block to hold round work in the "V," and this yoke, instead of spanning the sides of the block, is held in slots that are milled in the same face as the "V," so that the block will rest squarely upon any one of the other five sides.

Tapped holes are located in convenient places on each of the surfaces to facilitate clamping work to the block by means of screws and straps.

Black & Decker Battery Drill Stand

A special drilling stand has recently been placed on the market by the Black & Decker Manufacturing Co., Baltimore, Md., for the drilling out of terminals of storage batteries. The stand is very similar to that described on page 693, Vol. 53, of the *American Machinist*, but it is able to accomodate a greater height of work.

The stand holds the company's standard ¾-in. portable electric drill, which has a capacity up to ¾ in. when drilling in lead. It provides a vertical adjustment of the drill of 28 in., the feed motion, imparted by means of a hand lever, being 4½ in. The drill bit can be swung entirely around the column, being 7 in. from it. The extreme height is 46 inches.

Rewards for Suggestions

BY C. J. MORRISON

The question of rewards for suggestions has been troublesome with many concerns while others have had no trouble and have received many valuable suggestions. The successful concerns have, as far as known, handled the question of rewards on a square deal basis. They have endeavored to pay in proportion to the value of each suggestion and to convince the employees that the rewards were just. Naturally the sums paid varied from a few dollars to very substantial amounts. In one case, the award was so great that it was paid as a royalty extending over a number of years.

The idea was so simple that the management would not believe it would work, and here is where the spirit of the square deal made many thousands of dollars for the company and gave the employee a small fortune. The demonstration was undertaken to convince the employee that his suggestion was valueless. After the suggestion had proved its value, the employee stated that he had conceived the idea several years before, but had not presented it as the policy of the company at that time was to pay from one to ten dollars for suggestions.

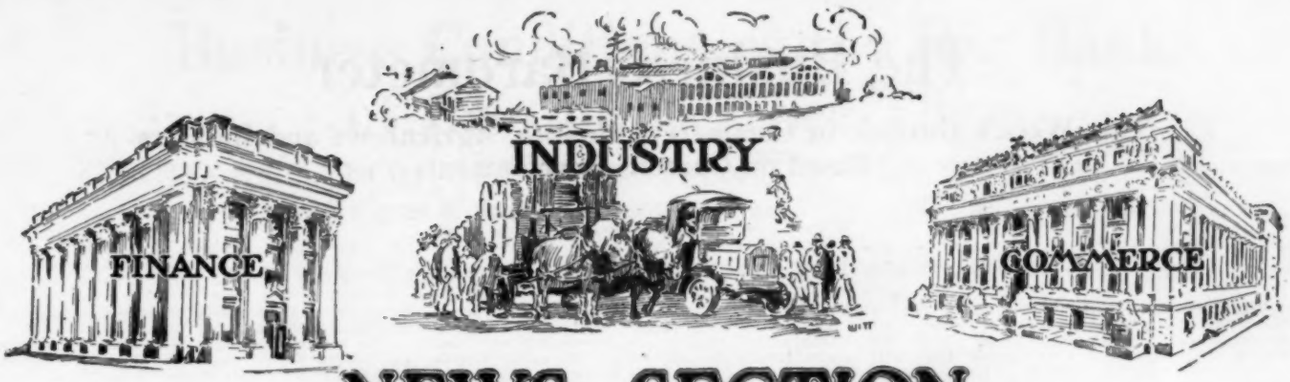
Right there is the crux of the whole matter. A reputation for square dealing must be established and the employees must be convinced that the rewards are fair, and when a suggestion is rejected they must be convinced that this action was also fair.

The suggestions can probably be handled best by a committee composed of members who are thoroughly familiar with the business, but they should in all cases consult with the employees making the suggestions and these consultations should be made in a friendly, mutually helpful spirit.

A concern was struggling with a problem of conveying material from one process to another without handling. Various methods had been tried without success and so-called experts gave nothing of value in return for their fee. One day a helper stopped a member of the suggestion committee and said, "Youse wise guys is still carrying that stuff." Asked if he knew any other way he replied, "Yes I know how, but can't write and can't explain. Bring up your committee and I'll show you." The committee was soon shown how to transport the material without handling.

The value of the suggestion could not be determined immediately as time would be required to make drawings and construct the device. Moreover there was the possibility that it might not work. But it did not seem best to keep the employee uncertain as to his reward. Consequently he was given a substantial check and told that more would follow when his suggestion had demonstrated its value. Ultimately he received a very handsome reward.

No idea should be scoffed at and thrown aside, but each should be given careful consideration and rejections should be carefully and tactfully explained.



NEWS SECTION

Steel Treaters Convene at Indianapolis Next Week

The American Society for Steel Treating will convene in Indianapolis, Ind., for its third annual convention, on September 19. The meeting will mark the first anniversary of the amalgamation into one great society of two societies devoted to the heat-treatment of steel, the formal proceeding of which took place in Philadelphia on Sept. 14, 1920. From every standpoint, the uniting of forces has been an advantage and the society has been able to exert an influence greater than would have been possible by two organizations having the same purpose.

The sessions will be spread over six days and will include the exhibition of heat-treating apparatus in the Manufacturers' Building, State Fair Grounds.

A. E. White, national president of the society will preside. The annual banquet will be held Thursday evening, the twenty-second.

Schwep Before Senate Committee on Tariff Bill

Testifying before the Finance Committee of the Senate, C. F. Schwep, of the Ingersoll-Rand Co., asked that the present tariff rate of 8 per cent on hollow drill steel be allowed to remain in effect, instead of the higher rates prescribed by the Fordney bill. He pointed out to the committee that the old type of percussion drilling differs widely in principle from hammer drilling. The hammer drill, he said, uses hollow steel and instead of lifting the steel in the chuck up and down the drill is tapped on the end. Due to the fact that the tool receives blows at the rate of 2,000 per minute, it must possess qualities which enable it to withstand this shock and vibration. Mr. Schwep declared that his company has found that there is something inherent in the Swedish steel, which is not revealed by analysis, which makes that steel much better adapted for the modern drill than is American steel. To place a prohibitive tariff on this article would interfere with the efficiency of operations which use this type of drill.

File Makers Ask More Duty on Imports

Application has been made to the Finance Committee of the Senate to increase materially the duty on files. Domestic manufacturers of files, which include some thirty makers of machine-cut files, suggest the necessity of levying a duty of 40 cents a dozen on files two and one-half inches in length and under; 75 cents a dozen on files over two and one-half inches, and under four and one-half inches in length; $1 on files over four and one-half inches and under seven inches in length; and $1.20 on files seven inches in length and over.

The tariff bill which passed the House prescribes rates of 25 cents, 47½ cents, 62½ cents and 77½ cents per dozen for each of the above groups respectively. It was stated that much keener competition from abroad may be expected since a vast amount of additional capital is being invested in the file industry in England, while the war had the effect of developing materially the industry in Sweden. Since nearly 90 per cent of the total cost of files is represented by labor, the United States is in no position with its high wage scale to compete with foreign manufacturers, it was said, unless adequate duties are provided.

Automotive Engineers To Visit Aberdeen Proving Ground

The Washington, Pennsylvania and Metropolitan sections of the Society of Automotive Engineers, together with members of the parent organization will visit Aberdeen Proving Ground on Oct. 7 at the invitation of Major-General C. C. Williams, U. S. A., Chief of Ordnance. Members of the American Society of Mechanical Engineers and the Army Ordnance Association will also participate in the visit and the latter organization will hold its annual convention at the Proving Ground on that date.

The Proving Ground is, in the opinion of engineering experts, the most complete establishment of its kind in the world and during the war a plant for the manufacture of guns and the loading of gas shells was constructed and put into operation there.

The invitation of General Williams provides an unusual opportunity to note the progress that has been made recently in the development of guns, projectiles, armor plate, bombs, aircraft and mobile mounts.

The meeting will begin early in the morning and will last through the entire day. Among the features of the program will be: (1) Firing of small arms, including tracer bullets from machine guns; (2) firing of mobile guns; (3) firing of major caliber guns from 12- to 16-in.; (4) demonstration of tanks, tractors and trailers; (5) demonstration of bomb-dropping from balloons and airplanes.

According to War Department regulations, admission will be limited to citizens of the United States with the exception of those manufacturing munitions for a foreign government which is at war.

Experts To Study Drill Steel

In the hope that they will serve as a consulting committee to study breakage and heat-treatment of drill steel, a joint invitation has been extended by the Bureau of Mines and the Bureau of Standards to the following engineers: B. F. Tillson, New Jersey Zinc Co.; F. W. Denton, Copper Range Co.; Dr. Van. H. Manning, American Petroleum Institute; Dr. J. A. Matthews, Crucible Steel Co.; W. L. Saunders, Ingersoll-Rand Co.

The Bureau of Mines, during the past year, has been doing some research work on drill steel. This has been conducted at the Rolla, Mo., station and at the Minneapolis station. It is recognized that improvements in drill steel have not kept pace with the improvement in drills. The Bureau of Mines, because of lack of appropriations, has not been able to give this problem the attention which it is recognized it should have. It is hoped that, through the co-operation of this committee and the Bureau of Standards, it will be possible to give this matter the attention it deserves.

German Competition in Latin-America

Cable advices to the Department of Commerce indicate that German firms are sending machinery to Latin-America on consignment, payment to be made when the sale is consummated. Even on that basis, little business is being done, it is reported. American machinery is reported as holding its own, despite the lower prices being quoted by the Germans. These prices are said to be from 10 to 25 per cent under the American prices. Better quality and packing and quicker delivery are offsetting the lower prices.

Society of Industrial Engineers at Springfield, Mass.

One of the most important industrial meetings of the year will be the fifth annual convention of the Society of Industrial Engineers, to be held in Springfield, Mass., Oct. 5, 6 and 7.

In the membership of this national organization are business executives and industrial engineers from almost every line of industry, which naturally tends to add interest to the national meetings.

Industrial Stability will be the main theme for discussion, the topics on the program covering four of the major functions of industry—production, finance and accounting, sales and industrial relations. All the speakers will be men of broad practical experience and national reputation.

Afternoon and evening sessions will be held on each of the three days, the mornings being devoted to visiting some of the most progressive plants in the Springfield district.

Metric System Hearings by Senate Sub-Committee

Hearings on a bill, providing for the compulsory adoption after ten years of the metric system of weights and measures, are to be conducted by a sub-committee of the Senate Committee on Manufactures, composed as follows: Senator McNary, Oregon, chairman; Senator Weller, Maryland; Senator Jones, New Mexico.

The sub-committee was appointed by Senator LaFollette, of Wisconsin, chairman of the Committee on Manufactures, at the request of Senator Ladd, of North Dakota, author of the metric bill introduced in the Senate at this session.

This bill provides among other things, that after a waiting period of 10 years no person shall sell any goods, wares or merchandise (except for export) nor charge or collect for carriage or transportation in or according to any other system than the metric system of weights and measures.

All trade, therefore, wholesale or retail, must then be carried on in a system now strange to our people. All postage, excises, duties and customs charged and collected by the Government will also have to be based on the metric system, the units of which bear no simple or easily remembered relation to the weights and measures now in use.

Under this proposed law the American people would be compelled to discontinue the use of the mile, the yard, the foot, the inch, the pound, the ton, the gallon and use the kilometer, the hectometer, the dekameter, the centimeter, the millimeter, the kilogram, the hectogram, the dekagram, the gram, the liter, the dekaliter, the hectoliter, etc., etc.

Asbestos Mining in Movies

The Bureau of Mines, Washington, D. C. has recently completed a motion picture film showing the asbestos mines of the Johns-Manville Co. and the various factories and processes in the mining, refining and manufacture of asbestos into its numerous products, such as roofings, insulations, packings, brake linings, asbestos textiles, papers and asbestos woods and other products.

The picture is in four reels and runs a little less than an hour. It is available for presentation by clubs, engineering societies, Y. M. C. A.'s, etc. Application should be made to the advertising manager, Johns-Manville, Inc., Madison Ave., at 41st St., New York City.

The Business Barometer

This Week's Outlook in Commerce, Finance, Agriculture and Industry Based on Current Developments

BY THEODORE H. PRICE
Editor, *Commerce and Finance*, New York

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"Happily there is a short crop of cotton this year," says Secretary Hoover, and although all economists know that he states a paradox, nearly every one will agree with him; for King Cotton, temporarily dethroned, has again regained his sceptre and under his leadership business is marching cheerfully toward prosperity.

The fact that a curtailment in the supply of one of the world's most necessary staples could work such a transformation in public sentiment is proof that conditions were sound and that all that was needed to reawaken constructive energy was some development that could be favorably construed. In reality a crop failure like a conflagration means a reduction in the world's wealth, but the San Francisco fire proved to be a blessing in disguise because it stirred men to action and provided work for everyone.

For a slightly different reason the cotton shortage promises to have the same effect. It has revived the spirit of adventure without which progress is impossible. In time, of course, this spirit will make some people the victims of their own enthusiasm, but that time is still distant and meanwhile it is only necessary to note that in nearly all the markets the light of a better demand is to be seen.

This is conspicuously true of wheat, which has advanced sharply. The reason assigned is that we have already shipped a third of our exportable surplus, estimated at 160,000,000 bushels, but the truth is that people have become courageous enough to anticipate the future.

The same thing is true of steel and iron. There is more buying and production is being correspondingly increased. The increase though slight as yet promises to be cumulative. Copper is also higher. So are building materials. Lath and lumber, cement and brick and glass and plaster are all being more freely bought. There is also a better demand for gasoline and tires, and the automobile people seem more cheerful although many of them are following Ford's lead in reducing prices. Hides and leather are likewise higher. At the wool sales in London and Australia an eager demand at an advance of from 10 to 15 per cent is reported and a large carpet auction in New York was a great success. In cotton textiles business has been halted somewhat by the violent advance in the raw mategial but it seems probable that cotton as well as its manufactured products will shortly become stabilized on a basis of about 20 cents for the former. The farmers seem disposed to sell at that figure and while no cotton famine is possible this season the producer is in command and cannot be expected to forego his hard won advantage.

Railroad traffic continues to gain. The net revenue for July promises to exceed $75,000,000 and August earnings may be still larger. It is suggested that by selling the $380,000,000 of equipment trust certificates which it owns the Government may be able to advance that sum to the roads without Congressional action and the executives show a repressed cheerfulness at the prospect.

The statement of the Federal Reserve Banks shows a further gain of $15,000,000 in the gold supply but this is at last commencing to have some effect upon loans and circulation which show an aggregate increase of $60,000,000 with the result that the reserve ratio has fallen from 66.8 to 66.2 per cent. The money market is easier at 5½ per cent for time loans and 5¾ per cent for commercial paper.

The stock and bond markets as a whole have been firm and higher. The stocks of railways which traverse the cotton states and of the companies that sell fertilizers have been helped by the advance in cotton and the securities that smell of Mexican oil are also higher upon the belief that the oil magnates now returning from Mexico City have arranged a *modus vivendi* with Obregon. Meantime Judge Gary of the Steel Corporation, not to be outdone by his fellow captains of industry, is on his way to the Mexican capitol and there are some who expect that our Government will recognize President Obregon now that the great corporations have condescended to call upon him. At all events Mexican bonds are higher and in Wall Street it is believed that the "ticker talks."

Noting all these evidences of the improvement I have so long predicted even the pessimists are becoming cheerful and a veritable chorus of optimism is to be heard from coast to coast and from the Rio Grande to the Great Lakes. By his letter to Senator McCormick recounting the achievements of his administration and describing the many good things yet to come President Harding has made himself the leader of this chorus while the tenor of Will Hays is to be heard as he sings that "every one knows that there is ahead the greatest era of expansion and prosperity the world has ever seen."

A building boom is reported from Chicago. Bradstreets and Duns agree that business is improving. The chief statistician of the American Telephone Co. says that the trade passing is 80 per cent of normal and that "it is becoming plain that depression breeds prosperity." Knoxville and a great many other towns report incipient booms. The editor of the *News Signal* of Middletown, Ohio, has published a 66-page paper proclaiming that "business is better" and the newspapers from one end of the country to the other seem agreed that good times have come again.

It is true that the antiphony of the unemployed is occasionally to be heard but most people think that their numbers have been exaggerated and are decreasing and that there will be work for every one who really wants it before the winter sets in. This view is in my judgment sustained by the facts and the thing most to be feared is that the underproduction in many lines from coal to canned goods will be manifest in great scarcity and high prices as the season advances.

The news from England is reassuring. De Valera seems to have talked too much, and the report that some of his Sinn Fein associates are now calling attention to the fact that he was born in America the son of a Spanish father and an Irish mother would indicate that sentiment is turning against him. This leads me to venture the prediction that through the patient diplomacy of Lloyd George the Irish question will be settled and the London Stock Exchange appears to agree with this view for it is strong and cheerful.

The only other European news that bears directly upon American business is the closing of the Berlin Stock Exchange, where trading has been suspended all week because of the decline in marks which sold in New York at 0.00993 cents each on Thursday last. This means that 10,000 marks worth about $2,400 before the war could have been bought for $99.75. It means also the ultimate demonetization of paper in Germany with all the pitiful distress that accompanies precipitate deflation. Without a currency that her people will accept Germany's ability to compete with the rest of the world will be temporarily at an end and while this will be in a sense reassuring to those who have feared the ghost of German competition its social and political consequences may be disturbing.

Other foreign exchanges have been remarkably steady when the break in marks is considered and for the present at least France and England appear to be prepared against the impending debacle in Germany. Whether they and the rest of the world can remain unaffected by the utter impoverishment of the German people is a question that the future must answer. Political economy and history suggest a negative reply.

To Reduce Pay of Navy Yard Workers

The Navy Wage Board has concluded extended hearings on the general subjects of the rates of pay and general policy affecting Navy Yard employees under the reduced appropriations. Representatives of machinists and all other classes of Navy Yard employees were heard. Judging from questions asked and statements made by members of the board during the hearing, it seems probable that a reduction of wages will be recommended. A general reduction of at least 5 per cent applied to all classes of Navy Yard employees is expected. At the same time, it apparently is the attitude of the board not to recommend a reduction to the level of outside industry just at a time when the rate of pay is particularly low in some establishments. There also is evidence that the board will not recommend the continuance of part-time work. The board evidently has no fault to find with the five-day week plan, as a temporary provision to prevent the throwing of a large number of men on the labor market at one time, but it was indicated clearly that this plan is not to continue long. The more efficient employees are to be retained and they are to be given an opportunity to work full time.

Army and Navy Contracts To Stand

Every effort is to be made by the Navy and War Departments to avoid cancellations of contracts as a result of the greatly reduced appropriations which will be available to these departments during the current fiscal year. High officials in each of these departments believe that cancellations can be avoided by slowing up the work and extending it over a much greater period than originally had been contemplated. At the Navy Department it was stated that manufacturers had displayed a most considerate attitude in meeting the situation and that there is every reason to think that an amicable understanding will be reached in a great majority of cases where the department will not be able to carry out its obligations in the exact manner in which it had been planned.

More Planes for Air Mail Service

The Air Mail Service of the Federal Government will soon place in operation six remodeled airplanes of the DH type on the transcontinental air mail route between New York and San Francisco. These planes are army planes and by changing the wing and body capacity they will carry double the amount of mail now carried in the Air Mail Service by this type of plane. Eight hundred pounds of mail or 32,000 letters will be carried on the remodeled plane with the same amount of fuel and the same man power, one pilot.

Fight Increased Tax on Motorcycles

Representatives of the motorcycle industry appeared before the Finance Committee of the Senate to urge a reduction in the duty provided in the Fordney tariff bill for motorcycles. In the bill as it passed the House, motorcycles are protected by a duty of 30 per cent ad valorem. The manufacturers asked that this be reduced to 15 per cent ad valorem. Under the Payne-Aldrich bill motorcycles were dutiable at 45 per cent ad valorem. This was reduced to 25 per cent in the Underwood Act. It was pointed out to the committee that American motorcycles have become very popular abroad and that the expansion of the export business is likely to be hindered by retaliatory duties if high rates are prescribed.

Business Conditions as the Big Banks of the Country See Them

The National City Bank of Chicago Sees Many Signs of Improvement

There are distinct signs that fundamental conditions are improving and that the basis is being laid for genuine business revival. Buyers are still cautious, and while some manufacturers are complaining at the dearth of orders compared with this season in other years, the conservatism in making new commitments is natural in view of the lack of confidence in future values. There is developing, however, a better undertone to general trade, and while the situation is still abnormal, yet the outlook is suggestive of sustained improvement in various lines. The extraordinary movement of grain to market has had a good effect. This influence is likely to go further as a consequence of the cuts in freight rates ordered by the Interstate Commerce Commission upon export shipments of grain and grain products as well as on flour. This action gives interest to the assertion by Secretary Wallace that the decline in the purchasing power of farm products below the average of other commodities has created a situation where the production of farm products is seriously threatened. The Secretary has pointed out that in Iowa the purchasing power of oats is just about 48 per cent of what it was from 1909 to 1914. This situation is very interesting and will be given serious consideration by railroad officials as there is much to be said for the theory that the prosperity of the railroads is largely dependent upon the prosperity of the farmers.

One of the most reassuring changes in the financial situation has been the continued strengthening of the country's bank position. Compared with conditions existing one year ago, the reduction (taking the figures of Aug. 17) in circulation has amounted to $671,000,000, the contraction from the high level of the war period being $901,000,000. Nothing perhaps better illustrates the changes in the credit situation than the decrease in notes during the first three weeks of last month of $30,000,000, as against an expansion during the corresponding period last year of $44,000,000. With the reserve ratio of the Federal Reserve system at the year's highest figure and the gold inflow from all quarters continuing, the bank position shows splendid strength. It is significant also that the great foreign banks are making headway in deflating their currency, which in the case of the Bank of England amounts to 10 per cent for the year, and the outstanding circulation of the Bank of France shows a decline from high point of last year of 2,651,000,000 francs. These gains are highly encouraging, but they must not be taken to mean that the credit strain has ended or that the credit situation is normal again. It is far from it, owing to the immense volume of frozen credits based on unsold stocks of cotton, wheat, sugar, rubber, wool and other material and merchandise. There is still a worldwide demand for credit accommodation to reckon with in connection with the continued demoralization of the foreign exchanges and consequent pressure upon the banks for long term credits to enable foreign buyers to take out produce and merchandise on a deferred settlement basis.

Reduced Exports

Recent developments in the foreign trade situation show that a point has been reached where it will be necessary hereafter for this country to compete actively for world trade. The government compilations show that July exports were $322,000,000, compared with $651,000,000 in that month last year, while imports amounted to $178,000,000, compared with $537,000,000 a year ago. It is interesting to note that of the $144,000,000 export balance shown last July, nearly half of it, or $60,534,000 was settled for by the net inflow of gold that month. The complete figures given out by the Commerce Department indicate a falling off of 23.8 per cent in the country's gross foreign trade for the year ended June 30, the total commerce having declined from $13,347,000,000 in 1920 to $10,171,000,000 in 1921. The total imports for the year of $3,654,000,000 showed a loss of 32.2 per cent, while exports of $6,516,000,000 within twelve months declined 19.6 per cent. Fully two-thirds of this decline was in raw materials due to the heavily decreased production of American factories as a result of shutdowns and part time operation. The principal causes for the falling off in export trade the Commerce Department summarizes thus: "With exchange rates on foreign currencies depreciated to a point which made prices in dollars prohibitive, with imports declining, with the impracticability of settling in gold the balances already due the United States, with the difficulty of arranging further credit facilities, with cancellations of orders, rejection of goods already shipped, and collection drafts dishonored, it was impossible for exports to continue at the rate of $500,000,000 or $600,000,000 a month, to which they had grown during the war."

Railroad Gains

There has been such an improvement in the railroad situation as to provide excellent basis for the prediction of Thomas DeWitt Cuyler, chairman of the Association of Railway Executives, that the industry has "turned the corner." The roads showed net operating revenue in June of $51,778,000. This was an advance of nearly $15,000,000 for the month, and compares with a net operating deficit of $14,612,000 in June, 1920. That the roads are reducing their abnormally high expense ratio is indicated by the fact that in June last 82.34 cents out of every dollar of revenue went for expenses, compared with 85.43 cents in May and 96.84 cents in June, 1920. These figures are very striking and indicate clearly that the roads are making consistent progress in getting the better of their unfavorable expense account and in fortifying their financial position. The surprising thing is that the railroads have done as well as they have, when it is recalled that net earnings declined from about $934,000,000 in 1917 to $62,000,000 in 1920. Almost any other industry would have been bankrupted by such a showing. There are definite indications, however, that the railroads are going ahead and that they will be able to retrieve much of what they lost during the interval when every gallery playing politician did his best to nag them and make it difficult for them to get along.

Immediate Problems

One of the biggest problems before the country has to do with providing employment for the great body of idle men and women. The unemployed class has been estimated at 5,500,000, which, reckoning on the usual basis of one breadwinner to sustain five people, means that 27,500,000 people of this country are temporarily without means of support except as they have recourse to savings accounts. This situation will be relieved, however, as the harvest progresses and the railroads give out large orders for supplies and equipment, which they will be able to do as soon as they receive from the government the $400,000,000 or $500,000,000 tentatively promised.

The Steel Market as a Guide

There is no better guide to the future of general business than the course of the steel market in the past. In the last twenty years there have been five distinct reactionary movements, and, what is interesting to note, the length of these movements has tended to shorten, which reflects the better stabilization of trade. The first of these reactions within the period mentioned occurred in 1904, which accompanied the financial troubles of that year. In 1903 the net earnings of the Steel Corporation were nearly $65,500,000. In 1904 they fell to less than $31,500,000. The cause was monetary stringency, which so contracted the financial credit of the larger consumers of steel and other products that projected improvements were abandoned. Two years later, when credit conditions improved, these plans were revived and the earnings of the Steel Corporation increased to more than $98,000,000. The second reaction occurred in 1908, when earnings fell to $45,634,000, against $105,247,000 in 1907. Enormous decrease in foreign trade, heavy gold exports, and the insolvencies of 24 of our railroads, were the prominent features of 1908.

A third reaction in the steel trade occurred in 1911-12, when the Steel Corporation's earnings averaged less than $55,000,000 a year. The causes of this reaction were widespread and fundamental. Europe heavily liquidated its holdings of American securities; diplomatic tension between France and Germany over the Morocco occupation threatened to embroil England; French capital loaned in Germany was recalled, producing a financial panic in Berlin; the hoarding of cash by the French people (an unusual development) reached unprecedented proportions, and despite a foreign trade balance in our favor in the fiscal year 1912, we exported more than $57,000,000 gold. The recovery from this reaction began in the latter part of 1912, and in 1913 U. S. Steel's profits were $82,000,000.

The slump during the last half of 1914, as everybody knows, was due to the outbreak of the World War. The subsequent recovery in 1915-16 was without parallel. It was based upon our immunity from participation in the war, the enormous increase in our export trade, and the freedom with which we extended financial credits to the belligerents, both as regards advances by the Federal Government and by individuals. The sharp and short reaction which occurred during the first half of 1919 was based on the mistaken belief that speedy readjustment to a peace basis would follow the signing of the Armistice. The recovery during the first half of 1920 was a genuine "flash in the pan" and the subsequent reaction during the last half of 1920 and the first half of the present year was one of the severest ever experienced by the trade.

This brief sketch of the course of our basic industry during the past score of years is made with the object of facilitating a study of the immediate future. The retrospect shows that invariably there were fundamental causes for each slump. The chief of these in the earlier reactions was our clumsy banking system, which was directly responsible for periodic currency panics. That cause has been eliminated by the operations of the Federal Reserve System. While this system lasts there will not be another currency panic in this country. In many of the reactions the cause was closely connected with foreign affairs, the United States being largely dependent upon foreign credits for trade expansion and upon foreign assistance in tiding us over our financial crises. European political troubles were invariably followed by a tightening of the money market and by a withdrawal of credits from this country. Conditions surrounding international finance have been completely reversed as a result of the war, and the kind of troubles experienced in the past are not likely to reappear.

At the present time underlying conditions of world trade are probably more complicated than ever before. The problems of public finance are most formidable, and are inextricably involved in world politics. Private enterprise cannot escape the influence. However, only the confirmed pessimist will despair of ultimate solution, and even he must admit that the United States is in better economic position to solve the problems of the future than ever before in our history.

Certainly we shall retain our pre-war volume of foreign trade and something in addition. It is within the possibilities that we shall have to write off some of the obligations of foreign governments to our government, but that event would not increase our fiscal burdens as a nation today; it would merely delay relief otherwise available if foreign governments would promptly pay interest and principal of debts due our government. In the meantime our domestic trade will increase. An enormous volume of this domestic trade has been backing up, and the situation as regards some of it is that buying for repairs, for replenishing exhausted stocks, and for new construction cannot be longer deferred. Recovery in volume will come more from innumerable rivulets of trade than from a sudden flood of business from an absolutely new source. The stream may rise almost imperceptibly, as during the past two months, rather than with a booming floodtide, but it will certainly rise.—*Peoples National Bank, Pittsburgh, Pa.*

Denver To Have Million-Dollar Iron Works

Within a year Denver, Col., is to have the largest iron works and machine shop west of Chicago. Articles of incorporation have been signed by four Denver iron and machine companies to erect a $1,000,000 plant to be known as the General Iron Works.

The new plant will consist of machine shop, foundry, boiler shop, pattern shop, forge works, storage and assembly rooms. The incorporators are T. B. Stearns, president of the Stearns-Roger Manufacturing Co.; T. A. Dickson, vice-president and general manager of the Colorado Iron Works Co.; Frank Shepard, president of the Denver Engineering Works; and Albert Cordingly, president of the Queen City Foundry Co.

The Queen City foundry will continue to operate its steel foundry and railroad casting works. The plant of the Denver Engineering Works and that of the Stearns-Roger Manufacturing Co., formerly of Pueblo, have been permanenty closed. All work of those organizations will be handled through a general plant in Denver.

The organization of the new corporation does not dissolve the four separate firms, and they will continue to maintain offices and clerical forces as before.

The board of directors of the new company includes: Thomas B. Stearns, president; T. A. Dickson, first vice-president; Frank E. Shepard, second vice-president; Albert Cordingly, third vice-president; R. W. Gordon, treasurer; C. L. Dean, secretary. Two other directors are A. B. Kennedy, first vice-president, and J. R. Henderson, second vice-president of the Stearns-Roger Co.

R. W. Gordon, general manager of the Stearns-Roger Co., and treasurer of the new organization stated that the purpose of the consolidation is to cut down overhead expenses and boost production to a point where Colorado firms can compete with Eastern manufacturing concerns on a scale never before attempted in the West. The new arrangement will obviate the necessity of sending a great number of orders to the East. Hereafter they will be turned out right in Denver.

Pending the completion of the new plant, the new consolidated concern will manufacture articles at the old plant of the Colorado Iron Works.

The Italian Shipbuilding Industry

Before Italy took possession of the new provinces there were ninety more or less important shipbuilding yards in the country. Today, there are 130 such establishments. Forty of them are almost without orders and about to shut down. The Venetian yards are working only four days per week. In Liguria more drastic measures have been taken a large percentage of the laborers having been discharged. The government is about to appropriate 250 million lire for the construction of merchant vessels, in order to keep at least a part of the yards occupied. But the Italian shipbuilding yards are seriously suffering from foreign competition, as every pound of coal and iron used in this industry has to be imported from abroad. In the Italian yards a ton of new buildings costs at least 2,000 lire, while the cost on the international market is but 600 lire. The largest Italian yards (Ansaldo Co. at Genoa and Sampierdarena, capitalized at 500 million lire) announce a reduction in wages of 50 per cent. It is feared that most of the other yards will have to follow these steps or to reduce the working time considerably.

Independent Steel Makers Protest Tariff

The rates of duty prescribed on iron and steel products in the tariff bill which has passed the House are inadequate, according to representations made to the Finance Committee of the Senate by the Independent Steel Manufacturers. This is particularly true because of the duties placed on raw materials. The bill is acceptable only, it was declared, because it contains American valuation, anti-dumping and bounty clauses. A plea was made for a return to the policy of free raw materials. By placing high duties on such materials as ferro-silicon, fluorspar, manganese, magnesite, pig tin and zinc, the cost of raw materials of the steel industry will be increased $24,000,000 per year, it was stated. Everything should be done to stimulate lower costs in the steel industry, it was declared, since the present capacity of the country is 20 per cent in excess of the home requirements.

W. L. Fenn, Machinery Builder, Dead at Hartford

Wilson L. Fenn, president of the Fenn Manufacturing Co., Hartford, Conn., died on July 26. He was one of the original incorporators of the Taylor-Fenn Co., and had been prominently associated with the manufacture of special machinery for a number of years

WILSON L. FENN

Mr. Fenn received his early training in the shops of the Pratt & Whitney Co., in Hartford, and he later organized the Taylor-Fenn Co., a combination of the Fenn and the Phoenix Iron Works. In 1915 he formed a partnership with his son which was known as the Fenn Manufacturing Co., of which he was president at the time of his death.

He is survived by a son, Wilson A. Fenn, who is general manager of the Fenn company.

The Austrian Magnesite Industry

(From the *Neue Freie Presse*. Transmitted by Carol H. Foster, American Mission, Vienna.)

A concentrating tendency in the Austrian magnesite industry has made progress lately. The Veitsch magnesite works have acquired a Tyrol deposit and the magnesite works of Kraubarth have gone over to the Alpine Montan concern. It is remarkable that such great quantities of raw magnesite are exported abroad. This is probably due to the fact that part of the newly established magnesite plants of Austria have as yet no foundries, and are therefore obliged to dispose of their raw magnesite.

Nine-tenths of the magnesite production is exported. While before the war the United States was the principal market for Austrian magnesite, the greater part of the export now goes to Germany. In 1920 the exported raw magnesite amounted to 99,710 metric quintals (1 metric quintal = 220.4 pounds). Of these 74,417 went to Germany, 12,448 to France, 480 to Italy, 146 to Sweden, 7,343 to Switzerland, 1,071 to Jugoslavia, and 3,794 to Czechoslovakia. The export of burned magnesite amounted to 525,596 quintals, of which quantity Germany also got the greater part, receiving 216,174 quintals; France, 29,970; England, 32,861; Italy, 12,685; Poland, 1,359; Rumania, 2,129 Jugoslavia, 1,138 Czechoslovakia, 510; and the United States, 195,025.

America last year purchased considerable quantities of Austrian magnesite, though its own output of magnesite has been nearly doubled over that of 1919. The output of magnesite in the states of California and Washington in 1920 attained 303,767 tons. In spite of this the import of burned magnesite in 1920 still amounted to 43,154 tons, and was thus three times as great as in 1919. Still the imports constituted only 15 per cent of the pre-war imports. These figures show that America can still be considered a great consumer of Austrian magnesite.

Austrian magnesite exports greatly increased in the first three months of 1921, amounting in that period to 213,000 quintals, which is 130,000 quintals more than in the previous year. Recently the great demand for magnesite has somewhat diminished. This is due no doubt to reduction of work in foreign steel and iron industries.

Fire, on Aug. 13, virtually destroyed the branch of the Ford Motor Co. at Issy-les-Moulineaux, a suburb of Paris. More than a hundred automobiles were in the building when the fire occurred, and the property loss is estimated at from 6,000,000 to 7,000,000 francs.

Improved Tendency in American Iron and Steel Trade

The sentiment in steel-trade circles is more cheerful than it was only a few weeks ago. There is a general tendency toward the belief that the worst has been passed, both in domestic and in foreign markets for steel, and that improvements may now be expected. In most quarters, however, no rapid or extensive improvement is looked for at an early date.

Low Point Probably Passed

Increased activities reported from blast furnaces and from rolling mills indicate some revival of buying to meet pressing current needs, to replenish diminished stocks, or to supply export demand. If this movement, which began about the first of August is sustained as is expected, July will prove to have been the turning point of the most severe depression in the recent history of the steel industry in the United States. The increase scale of operations at some plants has been reported to be substantially above the previous low levels, but for the industry as a whole it does not appear likely that the August figures of production will show anything more than a moderate move upward from the abnormally low record reached in July. Any upward tendency, however, is a welcome change from the uninterrupted downward course of the steel business during the last eight months.

There has been a good deal of discussion whether the steel industry is still a good barometer of general business conditions, because last year the steel trade was much slower than most others to show any pronounced effects of deflation of prices and approaching depression. Without attempting to settle this interesting question, it nevertheless is probably true that unmistakable evidence of revival in the steel industry will be regarded as an encouraging sign not only in steel-trade circles, but also rather generally by other business interests. For this reason the customary indices of domestic conditions—pig iron production, ingot output, and unfilled orders on the books of the United States Steel Corporation, for August—are awaited with considerable curiosity.

Export Market Quiet

The export markets for steel continue to be very quiet when compared with conditions of last year, and there are still many reports of an unbridged gap between prices quoted by Germany and Belgian producers and those which would leave no profit for American exporters. There is a growing tendency, however, to hold that a considerable element of artificiality is involved in the present form of German competition, and that comparatively slight changes from existing conditions would largely remove the difficulties which have been experienced on account of German offerings at absurdly low prices. Already, it is said, further downward revision of American prices, a rise in German prices, and some appreciation of the exchange value of the mark, have bettered the chances of United States exporters meeting German competition on certain lines of steel, and especially so where quality or delivery date is an important consideration.

Inquiries and firm orders for exports of steel are reported as more numerous than they were earlier in the year, although most of the buying is in relatively small lots, apparently to satisfy immediate needs. The only exceptions appear in railway material, and in pipe orders for oil-producing countries.

Airplane Service Between Reval and Stockholm

(Consul Charles H. Albrecht, Reval, Esthonia, July 18, 1921.)

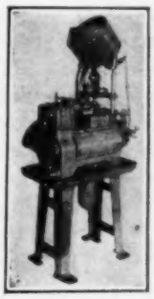
The Svenska Lufttrafik has established an airplane service between Stockholm and Reval. Two trips per week each way will be made, the trip to take three hours. Mail from Sweden and passengers both ways will be carried, there being accommodations for five passengers on each trip. A subsidy for carrying the mail is received from the Swedish government, and it is expected that the Esthonian government will also grant a subsidy to provide for carrying mail from Esthonia to Sweden.

A hydroplane with a motor of 185 horsepower and speed of 180 kilometers an hour will be used for the trips, leaving Stockholm on Mondays and Fridays at 12 m. (Swedish time) and leaving Reval on Tuesdays and Saturdays at 3:30 p.m. (Reval time—one hour later than Swedish time). The price of passenger tickets is 250 Swedish crowns ($52.50 at the average exchange rate of $0.21 for the Swedish crown, July 15-18).

Condensed-Clipping Index of Equipment

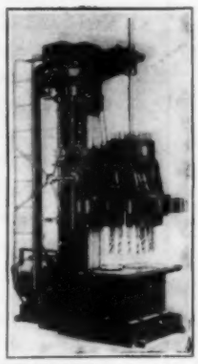
Patented Aug. 20, 1918

Tapping Machine, Nut, Automatic, Double-Spindle
Anderson Die Machine Co., Iranistan Ave., Bridgeport, Conn.
"American Machinist," June 2, 1921.



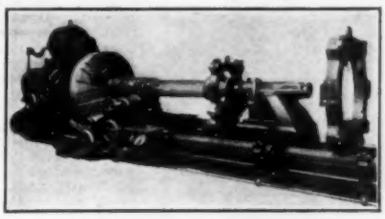
This machine incorporates new features in the reversing type of machine in that it is entirely automatic and has no clutches. Square or hexagon nuts ranging in size from $\frac{1}{8}$ in. to $\frac{3}{4}$ in. across the flats, from $\frac{1}{16}$ to $\frac{1}{4}$ in. in thickness, and having any size of hole up to 10-24 may be tapped at a rate of production of from 112 to 136 pieces per minute. The work is dumped into the hopper and by means of an agitator is fed through the curved chutes, the lower ends of which are fitted with shutters that hold the nuts, one at a time in each chute, in tapping positions. The machine is driven by a $\frac{1}{4}$-hp. motor, the drive being through a worm and wormwheel. The net weight of the machine is 500 lb., and it occupies a floor space of 18 x 24 in. The height to the center of the spindle is 43$\frac{1}{4}$ in., and the total height 66 inches.

Drilling Machine, Upright, Multiple-Spindle, D-32
Fox Machine Company, Jackson, Mich.
"American Machinist," June 2, 1921.



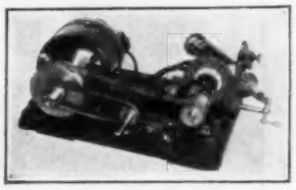
Provision is made for lowering and raising the spindle head by power, using an Ingersoll-Rand four-cylinder air motor mounted on the head. The machine is shown with a 20-in. round head having twelve spindles, each 2 in. in diameter. However, it can be furnished with any one of a variety of heads. The head has been mounted on a saddle in order to obtain a longer bearing on the column ways. Sliding gear transmissions are used for feed and speed changes, the shafts being mounted on Hyatt roller bearings. The machine can be equipped with an automatic tapping attachment so built that it is possible to reverse the spindles at any time during the tapping operation. Rotary tables can be furnished for the machine, so that loading can be done at the same time that drilling is progressing under the head. The machine weighs from 9,000 to 12,000 lb., depending upon the equipment.

Lathe, Triple-Geared, Heavy, 60-in., H. S. & G.
Houston, Stanwood & Gamble Co., Cincinnati, O.
"American Machinist," June 2, 1921.



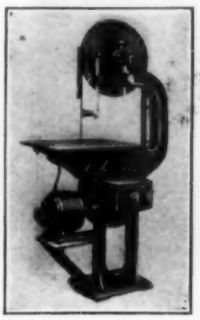
The bed of the lathe, which is 42 ft. long, is made in one section. The large steadyrest shown at the end of the lathe has a capacity of 23 to 37 in. and the smaller steadyrest has a capacity of 2 to 23 in. The carriage is equipped with a rapid power traverse. The lathe shown is equipped with a 35-hp., Westinghouse Type SK, d.c., 220-volt, variable-speed motor. Lubrication of the headstock is accomplished by means of a pump mounted at the rear of the lathe where it will be accessible for repairs. The apron is made with front and back walls to prevent bearings from shifting out of alignment. At the right-hand side of the apron are the motor controller bracket and dial by which the starting, stopping and reversing of the main motor are controlled. At the extreme right can be seen a recently patented support for the lead screw and controller roll. Net weight, 80,000 lb.

Grinding Machine, Portable, Automobile, Repair-Shop
Franklin Machine and Tool Co., Springfield, Mass.
"American Machinist," June 2, 1921.



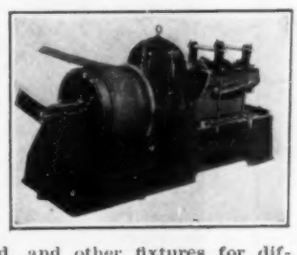
The machine is known as the Model "B" repair-shop unit, and is intended chiefly for grinding valves, sharpening reseating cutters and reamers, and for driving wheels, wire brushes or drills on the end of a flexible shaft. It consists of a flat base, on which is mounted a $\frac{1}{4}$-hp. motor, a grinding wheel running in bronze bearings and driven by a belt from the motor, an idler being provided to keep the proper belt tension. In the illustration, a double-ended valve-reseating tool is shown in position for grinding, this tool being used for machining the valve seats on the cylinder castings. Since the valve itself can be mounted in the same head for grinding, the same angularity can be obtained on the valve and on its seat. The machine can be adapted to other uses. When used with a flexible shaft directly connected to the end of the motor shaft, different types of tools can be driven.

Saw, Band, Metal-Cutting
Clark Machine Works, Belmont, N. Y.
"American Machinist," June 2, 1921.



This machine is a compact sprue-cutting saw for use in brass foundries and shops having to cut brass, bronze, aluminum or any of the softer metals which can be fed up to the saw by hand. The machine is ball bearing throughout, the bearings being so designed that they require no oiling. The drive is direct through a worm gear running in a special lubricant, the motor being controlled by a snap switch conveniently located on the under side of the table. It has a sliding-gear speed change operated by a handle on the outside of the gear-box, all gears running in an oil bath.

Burning-in and Running-in Machine, Automotive Bearing
Phoenix Manufacturing Co., Eau Claire, Wis.
"American Machinist," June 2, 1921.



The machine was designed to burn-in and run-in the main bearings on all makes of motor cars, trucks and tractors. The power is transmitted through a three-to-one gear reduction. The burning-in operation is done at a speed of 200 r.p.m., and the running in at 600 r.p.m. An especial feature is the solid Fibroid cone self-adjusting clutch, said to be especially adapted to the severe strains existing during the burning-in operations. The machine is of heavy construction, being ribbed and reinforced. Ford and Fordson fixtures are furnished, and other fixtures for different types of motors can be supplied. The machine weighs 2,200 lb. Height, 34$\frac{1}{2}$ in. Floor space occupied, 29 in. x 78 in.

Tool, Planing, Duplex, Dusenbury
Waltham Machine Works, Waltham, Mass.
"American Machinist," June 2, 1921.

The tool cuts in either direction, thus making it possible to take advantage of the ordinary idle stroke of a planer table. The cage seen at the lower part of the tool in the illustration, swivels upon the long bolt which passes lengthwise through the shank, and can be clamped in any desired position by the nut. The amount of the swiveling movement can be regulated and adjusted by means of four small screws. Within the cage are two "clapper blocks," so mounted as to swing toward each other, thus bringing the two cutting points fairly close together and avoiding the necessity for a long over run at the end of each table stroke. The tool may be used in any position, being intended for surfacing, for planing down the side, or for undercutting at an angle. The swiveling feature enables the operator to divide the amount of cut equally between the two cutting points, one for roughing and the other for finishing.

Chuck, Drill, Self-Tightening
Knebel Manufacturing Co., Middletown, Conn.
"American Machinist," June 2, 1921.

A spider, mounted on ball bearings, turns freely upon the central portion of the chuck, and the three jaws are attached to this spider by means of toggle joints. The shell is in two parts, the upper part being threaded to the central part or hub by a square thread, by means of which the chuck is tightened on a drill. The lower part of the shell is screwed to the upper part by a fine-pitch V-thread. The three holes for the jaws in the lower parts of the shell are round, and they cause the jaws to close in as the shell is turned back on the large square thread. The chuck may readily be taken apart for cleaning, and there are no loose parts to be mislaid or to be wrongly assembled. The chuck is made in two sizes to hold 0 to $\frac{1}{2}$ in., and 0 to $\frac{11}{16}$ in. drills, respectively.

Clip, paste on 3 x 5-in. cards and file as desired

Evolution of an "American Machinist" Article [VII]

Without illustrations it would be impossible to describe things mechanical; therefore a paper like the *American Machinist* must give considerable attention to that phase of its work. It is a duty of the editor to decide the size of a cut; this decision usually rests on the amount of detail that is necessary to be shown. He also decides on the advisability of using a headpiece. If reference letters are deemed necessary to make a description clear they are marked on tissue paper which is pasted over all photographs. This tissue paper serves to protect the photo and acts as a guide for the editor in checking it up after it is retouched and lettered. If it is a drawing

THREE VIEWS OF ILLUSTRATION DEPARTMENT

that is being lettered the editor marks his letters directly on the drawing. After an article is edited it is sent to the illustration department, together with the illustrations. Here it is decided what size a line-cut drawing should be, in order to get the proper reduction. The left-hand view shows the making of a line-cut drawing; these are generally made on tracing cloth, while cartoons are made on drawing paper. The right-hand view shows the retouching of a photograph. Here, important lines are made to stand out and, if specified, backgrounds are painted out by hand or by air-brush, or both. While most illustrations are sent in by contributors or are taken by editors on the road, there is considerable work done around our home district. This, together with much advertising work, keeps the company's field photo service department continually on the jump. Our last view shows a flashlight of the dark room, giving a good idea of the equipment carried.

Tractor Troubles in South Africa

There is a certain loss of power in internal combustion engines, due to the high altitudes met with in South Africa. This is to some extent modified by the lower average temperature at higher altitudes, but nevertheless the difference is considerable, approximately 10 per cent at 4,000 ft. and well worth consideration from the designer's point of view.

Engines should be sturdily built and able to give their full rated power at less than 1,000 r.p.m. It would be better if their general rate were nearer 600. The reduced speed of an engine working under these conditions leads to a very great increase in the working life of the engine and makes it a sweeter engine to run.

The South African soil after a drought becomes very hard, and even in what is considered easy soil hard patches are met with. Very little easily broken soil is found in the country. Under certain conditions clouds of dust are raised in the operation of plowing, and this is of a particularly fine penetrating type. The effect of dust on the engine can be readily imagined. The farmers of South Africa in considering the merits of plows usually insist on land being plowed in its hardest condition, for the reason that it would have to be plowed by oxen under similar conditions, and if a tractor will not do it the tractor is of no use to them.

The South African farmer does not usually employ a skilled mechanic ready to tune the engine to suit the varying temperatures. A machine that requires nursing is not desirable. The machine that is required is one capable of being overdriven and overworked in order to get the work done, and as soon as the machine has proved its worth the cheapest kind of labor will be employed to be put in charge of the tractor. Furthermore a cheap lubricating oil is likely to be used regardless of the possible effect on the tractor. There are, of course, certain farm owners who are more enlightened, but the tractor to be sold in South Africa must be capable of doing well under the worst conditions.

Machinery Exports in July

Oil-well machinery valued at $708,923 was exported during July, 1921, according to figures just made public by the Bureau of Foreign and Domestic Commerce. This compares with $458,704 in July of 1920. Exports of all other types of mining machinery during July, 1921, were valued at $482,677, as compared with $676,336 in July, 1920. Exports of pumps and pumping machinery in July, 1921, were valued at $513,749. This compares with $936,560 in July, 1920.

Business Items

The Porter-Cable Machine Co., Syracuse, N. Y., has taken over the production and sales of the Woodall-Basch drill and reamer holder, described in the *American Machinist* for March 24.

The Utica Drop Forge and Tool Co., manufacturer of nippers and pliers, has recently undergone a reorganization and is now doing business with R. B. Billings as president and J. S. Frazer as secretary and treasurer.

Commerce Reports, the official publication of the Bureau of Foreign and Domestic Commerce, Wash., D. C., will hereafter be issued as a weekly publication. All information and data will be classified on a commodity and geographical basis. The bureau is planning another method of distributing rush news as soon as received.

The Jones Auto-Drive Co., has been incorporated at Dover, Del., to manufacture a one-piece or solid rear axle drive. Capital stock reported as $500,000.

The Reliance Machine and Specialty Co., of Boston, Mass., has been combined with the Union Machine Co., of Fitchburg, Mass. The Jamaica plant of the former company will be moved to Fitchburg where it will be established in the Union Works in that city. The manufacture of self-lubricating bushings and bearings will be continued under the new arrangement.

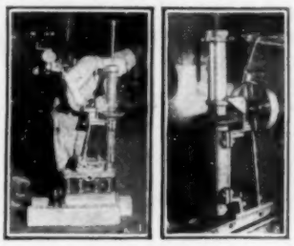
The Salem Die Co., Salem, Mass., has recently been purchased with its entire equipment, by the Joseph E. Knox & Co., diemakers, of Lynn, Mass.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Boring Machine, (Re-), Cylinder, Motor
Phoenix Mfg. Co., Eau Claire, Wis.
"American Machinist," June 9, 1921.

The machine is intended for reboring gas engine cylinders. By the use of the attachments which are supplied the machine can be used either as a hand machine, as shown in Fig. 1, or with power, as shown in Fig. 2. Cylinders can also be rebored without removing them from the chassis. The boring bar operates in an adjustable bearing, 13½ in. long. The cutter head is adjustable from 3⅜ to 4½ in., and with an extra set of blades will bore cylinders up to 5 in. in diameter. The machine weighs 160 lb.

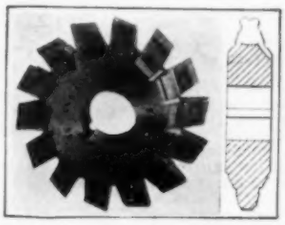


Boring Machine, (Re-), Cylinder, Type M
Storm Mfg. Co., Minneapolis, Minn.
"American Machinist," June 9, 1921.

The body of the machine is a casting which supports the boring bar and feeding and driving mechanism. The boring bar is of hollow carbon steel and is carried by two heavy adjustable bearings. It has a travel of 14 in. The cutter heads are of the six-cutter type, having universal adjustment by means of a central control. The machine is regularly furnished with a connection for a drilling machine, but can also be furnished with a belt pulley or with motor drive. The total capacity of the machine is from 2⅜ to 6½ in., and the weight approximately 300 lb.

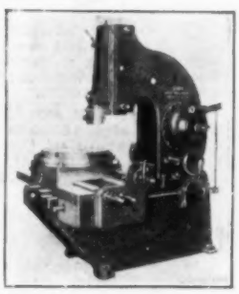
Milling Cutter, Gear, "High-Production"
Bonaffous, Bozonnet & Co., St. Ouen, near Paris, France.
"American Machinist," June 9, 1921.

The cutter is intended for production work in the cutting of gear teeth. It looks at first sight like a roughing cutter, but it is stated that it is not, as a very smooth finish can be obtained, as well as a correct profile. The cutter is relieved on a special milling machin As can be seen by the view on the left, the relieving is straight instead of curved, as is the case in the ordinary gear cutter. The cutter is not ground with the tooth faces radial, but in such a way that the tooth face is kept parallel to a certain diameter line through the tooth. The teeth of the cutter are nicked alternately in the manner shown by the top and bottom portions of the sketch at the right of the illustration. These nicks, or chip breakers, are intended to prevent chatter and to allow each tooth to remove a certain amount of metal.



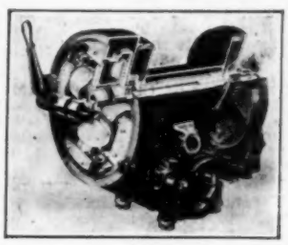
Slotting and Shaping Machine, Vertical
Jones Machine Tool Works, Philadelphia, Pa.
"American Machinist," June 9, 1921.

The machine is made in two sizes, with 6- or 10-in. stroke, and can be furnished equipped for either belt or motor drive. Power is transmitted through a friction clutch and a set of sliding gears, which allow three speed changes for the 6-in. machine and four for the 10-in. machine. The machine is equipped with the McCord quick-return mechanism, which is flood-lubricated, as are also the change gears. Power feeds for the saddle, cross-slide and rotary table are of the intermittent ratchet-fed type. The rotary table has an indexing plate with spring stop for accurate spacing. Quick indexing is a feature of the table, which can be rotated ½, ⅓, ¼, ⅛ or 1/12 of a circle. The 10-in. machine is equipped with quick power traverse to the saddle, cross-slide and table.



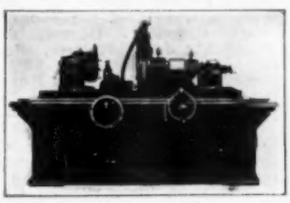
Hoist, Air-Operated, "Waugh oist," Model 250
Denver Rock Drill Mfg. Co., 39th Ave. and Williams St., Denver, Col.
"American Machinist," June 9, 1921.

The hoist is designed on the principle of a rotary engine, and the whole engine revolves within the motor housing, which is an oil and air-tight casing. A clutch pinion is mounted on the small end of the spider shaft, so that the cable drum gearing can be disconnected from the engine and the drum permitted to run free when desired. The hoist can be reversed instantly. Brake horsepower, 5 at 100 lb. air-pressure. Hoisting capacity, 500 to 1,000 lb. hoisted vertically at the rate of 68 to 143 ft. per minute. Drum capacity, 775 cu.in. of rope space, accommodating 1,000 ft. of ½-in. rope. Weight, 335 lb.



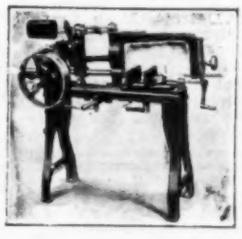
Grinding Machine, (Re-), Autopart
The Norton Co., Worcester, Mass.
"American Machinist," June 9, 1921.

The machine is so arranged that the various set-ups can be easily and quickly made, making it adaptable for the regrinding of crankshafts, as well as the grinding of pistons, pins, valves, etc. It has a swing of 18 in. and is 55 in. between centers. With the twelve work speeds provided, grinding can be performed on work of small as well as large diameter. The wheel slide weighs about 900 lb. and is equipped with a 26-in. diameter grinding wheel. The standard wheel feed mechanism is used. The movement of the feed index pin one space advances the slide one-eighth of a thousandth of an inch. A combined center and valve-face grinding attachment is furnished with the machine. Net weight, 7,600 pounds.



Saw, Hack, Power
Frontier Machine Tool Co., Inc., 128 Lakeview Ave., Buffalo, N. Y.
"American Machinist," June 9, 1921.

The saw is belt-driven and provided with an automatic stop and a positive clutch in the driving mechanism. A speed reduction of two to one is made in the gearing, the normal speed being 65 strokes per minute. Length of blade, 8 to 14 in. Stroke, 6 in. Cutting capacity, 5½ x 6 in. Vise: opening, 5½ in.; jaws, 4½ x 3 in. Pulley, 11 x 2⅜ in. Floor space, 36 x 18 in. Weight, net, 215 lb.; crated, 235 lb.



Hammers, Power, Compact Motor Drive for
C. C. Bradley & Son, Inc., Syracuse, N. Y.
"American Machinist," June 9, 1921.

The hammers built by the concern can now be furnished with electric motor drives. The drives are not direct, but through belts. On the compact hammer shown the motor is mounted on a bracket attached to the upright. This can be done with the upright types of machine. The application of motors and belts is clearly shown. Motors for alternating or direct current and with various voltages, phases and cycles can be furnished.

Clip, paste on 3 x 5-in. cards and file as desired

For the purpose of manufacturing automobile tool supplies, the South Bend Wrench and Tool Co., has been incorporated at South Bend, Ind., with a capital stock of $10,000. The organizers of the company are J. C. Romanie, B. V. Romanie and Emmet S. Webster.

British Furnaces, Ltd., Millbank House, London, S. W., England, has been organized for the purpose of manufacturing and selling surface combustion apparatus, as agents of the Surface Combustion Co., Inc., of New York. John H. Bartlett, Jr., foreign representative of the Surface Combustion company, had charge of the arrangements.

The Rex Manufacturing Co., has been organized and incorporated at Sheboygan, Wis., to manufacture all kinds of machinery, machine tools and factory equipment. Charles Voight, George Buchanan and R. Wesendorf are named as incorporators.

George L. Logan, manager of the Philippine district office of the Department of Commerce, announces that temporary quarters for that district have been established in the Ayuntamiento, executive building of the Insular Government.

The Moline Plow Co., Moline, Ill., has taken over the stock and plant of the East Moline Engine Co., and the work of moving the machinery and equipment into the former's plant is now progressing. The East Moline Co., builds engines for the Saxon automobiles, and for Universal tractors, Stevens cars and Moline trucks and tractors.

The Detroit Machine Products Co., has been incorporated under the state law of Delaware with a capital stock of $200,000. The new company will manufacture tools and machine parts.

The open air exhibition and demonstration of farm machinery has been added to the program of the Savannah Tri-State Exposition, to be held in October. Gratz Dent will have charge of this feature of the fair.

The Bunnell-Stevens Co., has been incorporated at Dover, Del., to manufacture engines and machinery.

Articles of incorporation have been filed for the Harrisburg Machine and Electric Welding Co., Harrisburg, Pa. John F. Weiss and Elmer E. Erb are mentioned as directors.

Announcement has just been made of the consolidation of the Rex File Co., the Vixen Tool Co., and the Heller Brothers Co., all of Newark, N. J.

The Henry & Wright Manufacturing Co., Hartford, Conn., has been reorganized through the efforts of Mrs. Daniel M. Wright, widow of the founder of the company. Charles J. Sorrells has been elected president; J. O. Hoover, vice-president; T. B. Owens, treasurer; and Mrs. Wright, secretary. Frank M. Rogers is general manager of the plant and W. G. Allen will be superintendent. Production of the Wright dieing machine will be continued.

The Middlesex Machine Co., of Middletown, Conn., builders of universal grinding machines, has been consolidated with the New Haven Sherardizing Co., of Hartford, Conn. The combination will move to a new plant at 868 Windsor St., Hartford, Conn., where it will be known as the Middlesex Machine Division of the New Haven Sherardizing Co. The company will continue to manufacture its line of grinding machines and will design and build special machinery and equipment. F. A. Brassill will continue as chief engineer.

The Mora Pump Co. has been organized at Ashland, Oregon, to manufacture and sell pumps and pumping machinery. The capital stock is $100,000. T. R. Kelly, H. E. Patton and James Caven are the incorporators.

The Vacuumeter Manufacturing Co. has been organized at Columbus, Ga., and incorporated under the state laws of Delaware. Capital stock is $500,000; directors are J. H. Farish, B. Crawford Jenkins and J. J. Albright.

The Universal Flying Machine Corporation has been organized at Philadelphia, Pa., with a capital stock of $50,000. The board of directors includes M. B. Pupp, Emil Sitte and Charles Pampe.

The Columbia Metal Stamping and Die Co., Cleveland, Ohio, has been incorporated with $10,000 capital stock. James M. McSweeney, M. E. Hurd, W. W. White, R. G. McCreary and G. M. Breen form the directorate.

The C. T. Dunkle Motors Co., Columbus, Ohio, has been incorporated. Directors include C. T. Dunkle, T. S. Hoff, C. A. Augustine and C. F. Shockler.

Personals

C. B. Cole, formerly president of the Tool Sales and Engineering Co., Chicago, Ill., has opened offices at 546 W. Washington Blvd., Chicago, Ill., as a consulting engineer, specializing on tools, gages and manufacturing systems.

Reuben Hill, formerly with the Yale & Towne Manufacturing Co., the Hudson Motor Co., and the Detroit Lubricating Co., is now secretary-treasurer of the Marlin Firearms Corporation of New Haven, Conn.

F. A. Brassill will continue as chief engineer of the recently combined Middlesex Machine Co., of Middletown, Conn., and the New Haven Sherardizing Co., of Hartford, Conn.

W. J. Drumpelmann has been appointed director of sales of the Saxon Motor Car Corporation, Detroit, Mich. Mr. Drumpelmann was recently with the Hudson Motor Car Co., and at one time was assistant sales manager of the Chalmers Motor Car Co.

R. B. Woodworth, a consulting engineer with the Carnegie Steel Co., Pittsburgh, Pa., has resigned.

Walter D. Craft, secretary-treasurer of the Vixen Tool Co., Newark, N. J., has been appointed domestic sales manager of the recently consolidated Rex-Vixen-Hellers companies.

Frank Johnson, automotive engineer, has joined the engineering staff of the Cadillac Motor Car Co., at Detroit. Mr. Johnson began his automotive career in Detroit in 1900, doing engineering work for a motor plant in that city. From 1901 until 1906 he was a chief draftsman and designer, having supervision over designing work on all parts of the Cadillac automobile and also on the tools for manufacturing the car.

Charles R. Ketteuring, of Defiance, Ohio, has been appointed special representative in the United States for the Chinese government. He will supervise the purchase of machinery to be used in commercial development.

D. D. Lewis, prominently identified with the steel industry and manufacturing plants for many years, has been appointed general manager of the Carroll Foundry and Machine Tool Co., of Bucyrus, Ohio. Mr. Lewis began his career in Johnstown, Pa. He served as general manager of the Southwark Foundry and Machine Co., of Philadelphia and was general manager of the Buckeye Engine Co., Salem, Ohio. Prior to that time he was identified with the Cambria Steel Co., of Johnstown, Pa. Mr. Lewis was affiliated with the late Tom L. Johnson, of Cleveland, when he built the Johnson Company Steel Mill at Lorain, Ohio. W. E. Matthew, who has served as secretary and general manager of the Carroll company for the last year, will devote his time exclusively to the Lamvert boring mill branch of the company's business, and will continue as secretary of the company as well as a member of the executive committee.

W. H. Archer, of Toronto, Canada, has been appointed locomotive foreman at the Grand Trunk shops at Stratford, Ontario, succeeding H. Battley who has left the service.

W. H. Moore, formerly manager of the New York office of the Garford Motor Truck Co., has recently been appointed manager of the Boston branch office.

George M. Wright, who retired some time ago as president of the Wright Wire Co., Worcester, Mass., a branch of the Wickwire-Spencer Steel Corp., has opened offices in the Park Building in Worcester, Mass., to engage in the manufacture of wire drawing machinery and equipment.

Henry C. Hood, of Detroit, Mich., was recently chosen sales manager for the Taylor-Brown Manufacturing Co., brass founders, Worcester, Mass.

E. L. Larson, general works manager of the Locomobile Company of America, Bridgeport, Conn., has resigned his position, effective September first.

Catalogs Wanted

R. Aguilar, B. 3a de las Artes No. 18, Tacubaya, D. F., Mexico, would like to receive catalogs and details of machinery built especially for making wood screws; also for making nails and tacks.

Trade Catalogs

Detroit Service Tools. Detroit Garage Equipment Co., Detroit, Mich. General Catalog No. 2 describing and illustrating tools and equipment for servicing Ford cars and trucks.

Pierce Packless Valves. Pierce, Butler & Pierce Manufacturing Corporation, New York, N. Y. Catalog No. 50 illustrating and describing, with full specifications and price lists, a line of packless valves.

Direct Current Motors. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin No. 1106-A, which is a revision of a previous bulletin on the subject of direct current motors and generators. Several new types are described.

Oldham Pneumatic Tools. George Oldham & Son Co., Baltimore, Md. Bulletin No. 10 illustrating and describing the Oldham chipping and calking hammers, riveters, holders-on, scalers and foundry hammers. Specifications for each type and model are included.

Obituary

Charles B. McManus, formerly president of the Interstate Tractor Co., Waterloo, Iowa, died in Chicago, on September first. At the time of his death he was connected with the Lincoln Motor Car Co., Chicago. Heart disease was the cause of his death.

Fred. A. Dexter, founder and president of the Leavitt Machine Co., of Orange Mass., died at his country home, Sunset Terrace, Mass., on Aug. 23. He was 58 years old. Mr. Dexter was prominent in civic and fraternal circles in Massachusetts and a well-known figure in the machine tool industry.

Louis J. Goldman, president and founder of the Goldman-Beckman Company, Cincinnati, Ohio, and president of the Cincinnati Electric Tool Co., died on Aug. 23. He was 71 years old.

Forthcoming Meetings

The second International Cost Conference will be held at Cleveland, Ohio, on Sept. 14, 15 and 16, under the auspices of the National Association of Cost Accountants.

The third annual convention and exhibition of the American Society for Steel Treating will be held in the Manufacturers Building, State Fair Grounds, Indianapolis, Ind., during the week of September 19 to 24 inclusive.

The annual congress of the National Safety Council will be held at Boston, Mass., during the week of September 26. C. W. Price, 168 North Michigan Ave., Chicago, Ill., is general manager.

The twelfth annual convention of the American Manufacturers Export Association will be held in the Waldorf-Astoria Hotel, New York City, on October 5 and 6. A. W. Willmann is secretary.

The fifth annual convention of the Society of Industrial Engineers will be held at Springfield, Mass., Oct. 5, 6 and 7.

A joint meeting of the American Society of Mechanical Engineers, the Society of Automotive Engineers and the Army Ordnance Association will be held at Aberdeen, Md., Friday, October 7.

The annual meeting of the National Association of Purchasing Agents will meet in the Claypool Hotel, Indianapolis, Ind., on Oct. 10 to 13, inclusive. L. F. Boffey, 19 Park Place, New York City, is secretary.

The American Gear Manufacturers Association will hold its semi-annual meeting at Rochester, N. Y., October 13, 14 and 15. F. D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa. is secretary.

The National Machine Tool Builders' Association will hold its fall meeting at the Hotel Astor, New York City, October 18, 19 and 20.

The third annual convention and exhibition of the American Gas Association will be held in the Congress and Auditorium Hotels, Chicago, Ill., on Nov. 7 to 12.

NEW *and* ENLARGED

Machine Tools and Machinery Wanted

Machine-tool wants published without charge

Conn., East Portchester—The Portchester Pneumatic Tool Co.—screw machine with collet, 2 in. capacity, also surface grinder, Brown & Sharpe Preferred.

Md., Baltimore—The Machinery Clearing House Corp., Pratt St.—motor driven lathes, 6 ft. 6 in. and 8-10 ft. between centers.

N. Y., Batavia—The Ardia Motor Car Corp.—
One 36 in. planer.
One double spindle shaper.
One band saw, 36 in. table.
One jointer, 20 in. minimum.
Cut-off saw.
Oliver or American mortising machine.
One 36 in. turning lathe.
One 10 ft. Cornice brake for power and hand, for 10 gauge steel.
One large and one small power hammer.
One spot welder, 20 in. throw.
One Acetylene welding outfit.

N. Y., Long Island City—Long Island Fdry. Co., 11th and 12th Sts., and Vernon Ave.—one 24 in. x 5 ft. metal spinning lathe for pattern makers use complete.

Ala., Birmingham—The Woodward Iron Co., Coal, coke, pig iron, etc. J. T. Leonard, Purch. Agt.—One single spindle boring mill, two speed, one piece table, vertical, lateral, transwise and angular adjustment, for heavy castings; about 36 in. will be average size of material used.
One direct geared electric grinding wheel for dressing tools, etc.
Two-wheel machine with steady rests, 1200-1500 r.p.m., prefer "Geometric," 36 in. between centers. One 1½, one 3 and one 5 ton monorail overhead electric cranes, 25 cycle, handling pig iron. Bids are not to include rails.

Ala., Overton—The Alabama Fuel and Iron Co., DeBardeleben, Purch. Agt.—machinery for installation of 2 machine shops for mine of 2,500 ton per day.

Tenn., Mooresburg—G. M. Bolinger—one broom handle lathe and one small planer and matcher (used).

Va., Norfolk—The Atlantic Supply Co., Inc., 421 Water St., J. S. Moore, Secy. and Treas.—one 12 to 14 in. four side moulder, (used in good condition).

Va., Richmond—Layne Auto Service Co., 7th and Leigh Sts., J. R. Layne, Purch. Agt.—small lathe, light power drill and electric test bench.

Va., Richmond—R. Walker, 1639 West Broad St.—regrinding machine, drill press and medium size lathe (new or used).

Ill., Chicago—Woodward Automatic Control Co., 933 Washington Blvd.—No. 3 punch press.

Ill., Rock Island—J. M. Schaab, 1601 4th Ave.—lathe and drill press.

Mich., Detroit—J. Doran, 270 East Milwaukee Ave.—machine shop equipment for proposed shop on Epworth Blvd.

Mich., Flint—The Buick Motor Co.—Portable scrap shear.

O., Cleveland—The Cleveland Plating Co., 3620 Superior Ave., N. E.—eight ft. squaring shears for 14 gage steel.

O., Cleveland—A. E. Kilroy, 9407 Ramona Blvd., builder—punch and shears, drill presses and trolley runways for steel shop to be erected at 13800 Miles Ave.

O., Columbus—The Bd. Educ., High and Town Sts., E. L. McCune, Clk.—manual training equipment including 2 Oliver trimmers, 2 band saws 30 in., and 2 grinders for Taylor Ave. and Linden St. schools.

Wis., Janesville—The Parker Pen Co., East Milwaukee Ave., manufacturer of fountain pens—C. & P. 10x15 in. press with Miller automatic feed attachment.

Wis., Milwaukee—W. Ehmke, 105 5th St.—one 28 in. iron folder.

Wis., Milwaukee—A. E. Kossow, 473 16th Ave.—one engine lathe.

Wis., Milwaukee—M. Wald, 591 12th St.—one 30 in. tinners folder.

Wis., Prairie du Sac — The Wisconsin School Bo.—manual training machinery also forge and blacksmith equipment.

Ia., Des Moines—The Bd. Educ. c/o G. L. Garton, Secy.—manual training equipment for proposed high school.

P. R., San Juan—The Government of Porto Rico, Purch. Agt., 29 Comercio St., also 17 Battery Place, New York City. American speed lathe.

N. J., Camden—N. G. Wilson Motor Co., c/o W. P. Hallin, 530 Market St.—Machinery for proposed auto sales and service station on Haddon Ave. and Whitehorse Pike.

N. J., Trenton—The Star Porcelain Co., Muirhead Ave.—clay working machinery.

N. Y., New York—V. Lowener's New York Office, 114 Liberty St., K. Engelsted, mgr.—Looms for fence wire weaving.

N. Y., Syracuse—Groves Industrial Requirements Co., 227 Palmer St.—one 20 ton, 8-wheeled locomotive crane with 50 ft. boom and 7½ kw. generator, (used).

N. Y., Tonawanda—F. I. Savitz, 340 Main St.—paper ruling machine.

Pa., Altoona—W. N. Becker, Secy. of the School District, 6th Ave. and 15th St., will receive bids until Oct. 3 for mortiser and shaver machines for use in vocational training shops. Estimated cost, $1,200. C. E. Hedden, Supervisor vocational shops.

Fla., Jensen—The Jensen Ice Wks., H. J. Schultz, Secy and Treas.—Complete machinery and equipment for the manufacture of ice.

Ga., Cartersville—Big Tom Barytes Co., W. C. Satterfield, Purch. Agt.—One or two Raymond 4 roller mills with pneumatic separator for ochre and barytes mines and mills.

Ga., Tate—The Georgia Marble Co., H. L. Litchfield, vice-pres. — complete stone working machinery.

Ky., Paducah — The Ohio-Kentucky Fluorspar & Lead Corp., Inc., F. B. Moodie, Vice-Pres. and Treas.—Jigs, rolls, crushers, tables and other machinery for use in mining fluorspar and lead.

N. C., Lexington—The Elk Furniture Co., J. L. Gilmore, Secy.-Treas.—one Mattison No. 57-B automatic turning lathe (used but in first class working condition).

N. C., Mt. Airy—The North Carolina Granite Corp., W. S. Martin, Secy. & Treas.—
One belt-driven band saw with iron tilting table, size 32 in. to 36 in., to be used to saw out felloes, etc., up to 6 in. thick, also to make simple patterns in 1 in. stock and similar work.
One small belt-driven wood planer, single surfacer or Pony type.
One belt-driven iron planer, single post machine would do but prefer one with single top and side head, length of plate from 6 to 7 ft., width 24 in. to 30 in. Give approximate weight and freight rate to Mt. Airy.

S. C., Prosperity—The Prosperity Cotton Oil Mill Co.—flour mill machinery and equipment.

Tenn., Newport—W. A. Nelson, manufacturer of ice—complete machinery and equipment for 10 to 15 ton ice plant.

Tenn., Nashville—The Rocky River Coal & Lumber Co.
Complete tight barrel heading outfit with one turner.
Six joiners, line shafting and pulleys.
Dry kiln equipment, with or without power.
Two complete heading mills, without power, line shafting, pulleys, belting, edger.
Two 58 to 60 in. saws (used if in good condition).
Two low down stave wheel listers, complete with knives.

Va., Milford—W. Wilson—planing mill machinery.

Wis., Haugen—The Haugen Box & Crating Co., J. E. Lee, Purch. Agt.—woodworking machinery, including saws, planers, mortiser, jointer, etc.

Wis., Maribel—The Maribel Strawcutter Co., c/o H. Glover—machinery for proposed factory.

Wis., Owen—W. F. Weaver Co.—planers, punches, sawing machines, vises and special wood-working machinery.

Wis., Portage—The Portage Co-Operative Canning Co., Michel Bldg.—canning and conveying machinery.

Wis., Prairie du Sac—The Wisconsin River Power Co.—machinery for proposed power and machine shop.

Wis., Watertown—W. Hartig, 100 Cady St.—$15,000 worth of machinery for ice cream factory, to include all special ice machinery, coolers, mixers, etc.

Wis., Waukesha—The Manitowoc Church Furniture Co., C. F. Schuetze, Mgr.—woodworking and special furniture machinery.

Wis., Waukesha—C. F. Schuetze, 1214 Lincoln Ave.—wood-working machinery.

Ia., Davenport—The Davenport Ice Co., 1st and Myrtle Sts.—machinery for the manufacture of ice.

Tex., Dallas — Stickle Lumber Corp., 214-19 Dallas County State Bank Bldg., A. W. Stickle, Pres.—Machinery for the manufacture of lumber, etc.

N. B., Moncton—R. C. Tait—$10,000 worth of saw mill equipment.

Ont., Guelph—Flax Spinners, Ltd.—Machinery to replace that which was destroyed by fire. Loss $100,000.

The Weekly Price Guide

This Week's Market

Soft steel bars and bar shapes have been quoted at $1.69@1.70, Pittsburgh; with plates at $1.65@1.70 and steel shapes at $1.75@1.80 per 100 lb. Mill shipments, New York, of structural shapes, are quoted at $2.13@2.23; plates at $2.08@2.13 and bars at $2.03 per 100 lb. Steel warehouse prices have remained firm throughout the week.

New York reports an advance of ¼c. in tin, making the present price 27¼c. as against 26¾c. per lb. Copper bars have been reduced from 18¼c. to 18c. and brass tubing from 18¼c. to 18c. per lb. Solder has advanced from 17¾c. to 19¼c. per lb. (case lots).

Chicago metal market shows a reduction of ¼c. per lb. on the following metal products: brass sheets, rods and tubing; copper sheets and tubing and aluminum ingots. Copper bars are quoted at 17¼c. as against 18¼c. per lb. Advances ranging from ¼c. to 1c. per lb. are quoted in old metals. Increased discounts are shown on shop supplies and linseed-oil is quoted at 84c. as against 80c. per gal.

Cleveland reports a decrease of ¼c. in copper sheets and a rise of 1c. per lb. in babbitt metal (best grade).

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	*$24.50
Northern Basic	†21.52
Southern Ohio No. 2	†22.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	†30.26
BIRMINGHAM	
No. 2 Foundry	*20.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75 sil.	†21.76
Virginia No. 2	†28.74
Basic	19.76
Grey Forge	21.26
CHICAGO	
No. 2 Foundry local	21.00
No. 2 Foundry, Southern, sil 2.25@2.75	†26.66
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	†22.96
Basic	†21.46
Bessemer	†21.96

*F. o. b. furnace. † Delivered.

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	2.25	3.28	3.10	3.38
No. 12	2.35	3.33	3.15	3.43
No. 14	2.45	3.38	3.20	3.48
No. 16	2.55	3.48	3.30	3.58
Black				
Nos. 17 and 21.	2.60	3.80	3.55	3.95
Nos. 22 and 24.	2.65	3.85	3.60	4.00
Nos. 25 and 26.	2.70	3.90	3.65	4.05
No. 28	2.75	4.00	3.75	4.15
Galvanized				
Nos. 10 and 11.	2.75	4.00	3.75	4.15
Nos. 12 and 14.	2.85	4.10	3.85	4.25
Nos. 17 and 21.	3.15	4.40	4.15	4.55
Nos. 22 and 24.	3.30	4.55	4.30	4.70
No. 26	3.45	4.70	4.55	4.85
No. 28	3.75	5.00	4.75	5.15

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of July 7, 1921:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
1 to 3	64½	52	⅜ to 1¼	39½	24½
LAP WELD					
2	56½	44	2	34½	20½
2½ to 6	60½	48	2½ to 4	37½	24½
7 to 12	57½	44	4½ to 6	37½	24½
13 and 14	45	37	7 to 12	35½	22½
15	42½	32			
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
1 to 1½	62½	51	1 to 1½	39½	25½
2 to 3	63½	52			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	54½	43	2	35½	22½
2½ to 4	58½	47	2½ to 4	38½	26½
4½ to 6	57½	46	4½ to 6	37½	25½
7 to 8	53½	40	7 to 8	30½	18½
9 to 12	48½	35	9 to 12	25½	13½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

WROUGHT PIPE—Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	60%	46%	52½%	43½%	62½%	50%
3½ to 6 in. steel lap welded	51%	37%	55½%	40½%	48½%	46%

Malleable fittings. Classes B and C, Banded, from New York stock sell at plus 6%. Cast iron, standard sizes, 15% off.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (heavy)	5.00	6.50	8.25
Spring steel (light)	6.00@8.00	6.50	10.50
Coppered Bessemer rods (base)	8.00	8.00	6.03
Hoop steel	3.88	3.29	3.48
Cold rolled strip steel	7.50	8.25	7.25
Floor plates	4.85	2.74	5.23
Cold finished shafting or screw	4.23	3.85	4.00
Cold finished flats, squares	4.73	4.35	4.50
Structural shapes (base)	2.88	2.74	2.88
Soft steel bars (base)	2.78	2.64	2.78
Soft steel bar shapes (base)	2.78	2.64	2.78
Soft steel bands (base)	3.43	.....	.....
Tank plates (base)	2.88	2.92½	2.88
Bar iron (mill 2.25)	2.78	3.52	2.78
Drill rod (from list)	55@60%	55%	50%
Electric welding wire	New York		⅜, 8½c. per lb.

⅛—7.15c.; 5/32 to ¼—6.75c. Swedish iron sells at 18½c. per lb. in Chicago

METALS

Current Prices in Cents Per Pound

	New York	Cleveland	Chicago
Copper, electrolytic (up to carlots), New York	12¾@13		
Tin, 5-ton lots, New York	27.25		
Lead (up to carlots), St. Louis, 4.35; New York	4.75		
Zinc (up to carlots), St. Louis, 4.60; New York	5.00		
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.00	25@26	21.00
Antimony (Chinese), ton spot	5.25	6.00	6.00
Copper sheets, base	19.75	20.50	19.50
Copper wire (carlots)	15.50	15.50	14.00
Copper bars (ton lots)	18.00	22.00	17.50
Copper tubing (100-lb. lots)	19.50	23.00	19.50
Brass sheets (100-lb. lots)	15.25	18.00	15.25
Brass tubing (100-lb. lots)	18.00	20.00	18.00
Brass rods (1,000-lb. lots)	13.25	15.50	13.25
Zinc sheets (casks), (8% dis. carlots)	11.00	11.15	15.75
Nickel (ingot and shot), Bayonne, N. J.	41.00	.....	.....
Nickel (electrolytic), Bayonne, N. J.	44.00	.....	.....
Solder (½ and ½), (case lots)	19.50	23.50	17.50
Babbitt metal (best grade)	70.00	36.50	35.00
Babbitt metal (commercial)	30.00	13.50	9.00

—Shop Materials and Supplies

MONEL METAL Base price in cents per pound, f.o.b. Bayonne:

Shots and blocks	$35.00	Hot rolled rods (base)	42.00
Ingots	38.00	Cold rolled rods (base)	56.00
Sheet bars	40.00	Hot rolled sheets (base)	55.00

Special Nickel and Alloys

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	9.50	9.00	9.50
Copper, heavy, and wire	9.00	9.00	9.00
Copper, light, and bottoms	7.00	7.00	8.00
Lead, heavy	3.25	3.00	3.50
Lead, tea	2.00	2.00	2.75
Brass, heavy	5.00	5.00	7.25
Brass, light	4.00	3.00	4.50
No. 1 yellow brass turnings	4.50	4.00	4.75
Zinc	2.50	2.00	2.50

TIN PLATES—American Charcoal Plates—Bright

			New York	Cleveland	Chicago
"AAA" Charcoal Melyn Grade:					
IC,	20x28,	112 sheets	21.50	.....	.....
IX,	20x28,	112 sheets	24.00	.....	.....
IXX,	20x28,	56 sheets	13.75	.....	.....
IXXX,	20x28,	56 sheets	15.50	.....	.....
IXXXX,	20x28,	56 sheets	17.00	.....	.....
"A" Charcoal Allaways Grade:					
IC,	20x28,	112 sheets	18.50	.....	.....
IX,	20x28,	112 sheets	21.50	.....	.....
IXX,	20x28,	56 sheets	12.25	.....	.....
IXXX,	20x28,	56 sheets	14.00	.....	.....
IXXXX,	20x28,	56 sheets	15.75	.....	.....

Coke Plates, Bright

Prime, 20x28 in.:			14x20 in..
80-lb,	112 sheets	13.60	....
90-lb.,	112 sheets	13.80	....
100-lb.,	112 sheets	14.00	6.50 .....
IC,	112 sheets	14.30	6.65 .....
IX,	112 sheets	16.30	....
IXX,	56 sheets	9.15	....
IXXX,	56 sheets	10.15	....
IXXXX,	56 sheets	11.15	....

Terne Plate

Small lots, 8-lb. Coating:				
100-lb.,	14x20	$7.50	6.25	6.25
IC,	14x20	7.75	6.50	6.50
IX,	14x20	8.00	7.00	7.00

SHOP SUPPLIES

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	—50%	—60%	—60-5%
1⅛ and 1¼x3 in. up to 12 in.	—40%	60-10-10%	—55%
With cold punched sq. nuts	—30%	.....	....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	—40%	.....	....
Up to 1-in. diameter, with cold punched hex. nuts (plus std. extra of 10%)	—30%	.....	.....
Button head bolts, with hex. nuts	—20%	390 base	....
Hex. head and hex. nut bolts	—20%	.....	.....
Lag screws, coach screws	—50-10%	.....	.....
Carriage bolts, all sizes up to 1 in. x 30 in.	—45%	50-10-10%	50-5%
Bolt ends, with hot pressed nuts	—50%	.....	.....
Tap bolts, hex. heads	—20%	.....	.....
Rivets, ⅛ in. dia. and smaller. *New list*	-50-10%	60-10-10%	-60-10%
Rivets, tinned	-50-10%	60-10-10%	—45%
Semi-finished nuts, all sizes	—70%	75%	50%
Case-hardened nuts	—60%	.....	.....
Washers, cast iron, ½ in., per 100 lb.	$5.00	$4.50 off	$4.50
Washers, cast iron, ⅝ in. and larger, per 100 lb	4.25	3.75 off	4.50
Washers, round plate, off list per 100 lb.	3.00	.....	.....
Nuts, hot pressed, sq. Off list	2.00	3.00	3.25
Nuts, hot pressed, hex. Off list	2.00	3.00	3.25
Nuts, cold punched, sq. Off list	1.50	3.00	3.00
Nuts, cold punched, hex. Off list	1.50	3.00	3.00
Rivets:			
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb	$4.40	3.50	3.68
Cone heads, ditto	4.50	3.60	3.78
1⅛ to 1¾-in. long, all diameters, *EXTRA* per 100 lb	0.25	.....	....
⅞ in. diameter *EXTRA*	0.15	.....	....
½ in. diameter *EXTRA*	0.50	.....	....
1 in. long, and shorter *EXTRA*	0.50	.....	....
Longer than 5 in *EXTRA*	0.25	.....	....
Less than 200 lb *EXTRA*	0.50	.....	....
Countersunk heads *EXTRA*	0.35	.....	....
Copper rivets	50-10%	40-10%	50%
Copper burs	25-10%	15%	20%

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.07½@$0.10	$0.12	$0.12
Cotton waste, mixed, per lb.	.055@.09	.09	.10
Wiping cloths per M., 13¼x13¼	.....	55.00	55.00
Wiping cloths per M., 13¼x20½	.....	65.00	65.00
Sal soda, 100 lbs	2.10	3.00	2.65
Roll sulphur, 2-bbl. lots per 100 lb	2.55	3.25	2.75
Linseed oil, per gal., 5 bbl. lots	.78	.83	.84
Fire clay, per 100 lb	(Ottawa, .80)	.80	
White lead, dry or in oil	100 lb. kegs.	New York, 12.25	
Red lead, dry	100 lb. kegs.	New York, 12.25	
Red lead, in oil	100 lb. kegs.	New York, 13.75	
Coke, prompt furnace	$3.00@3.25	Connellsville	
Coke, prompt foundry	4.00@4.50	Connellsville	

Metal Working Shops

NEW ENGLAND STATES

Conn., Hartford—Dragat & Troubman, 340 Windsor Ave., will soon award the contract for the construction of a 3 story, 95 x 100 ft. garage on Windsor Ave. Estimated cost, $100,000. G. A. Zunner, 182 High St., Archt.

Conn., Hartford—K. B. Noble Co., 249 Pearl St., has awarded the contract for the construction of a 3 story plant on Pearl and South Ann Sts., for the manufacture of contractors equipment. Estimated cost, $30,000.

Mass., Northampton—F. Girard, King St., is having plans prepared for the construction of a 1 story, 100 x 125 ft. garage, etc. on North St. Private plans.

Mass., Somerville—J. H. Atamian, 275 Beacon St., will build a 1 story, 75 x 169 ft. garage, etc. on Beacon St. Private plans.

Mass., Springfield—The Hampden Tool Co., 344 Main St., has awarded the contract for the construction of a 1 story, 40 x 90 ft. tool shop on St. James Ave. Estimated cost, between $10,000 and $12,000.

MIDDLE ATLANTIC STATES

N. J., Camden—The N. G. Wilson Motor Co., c/o W. P. Hallin, 530 Market St., has awarded the contract for the construction of a 1 story, 60 x 200 ft. sales and service station on Haddon Ave. and Whitehorse Pike. Estimated cost, $75,000.

Pa., Philadelphia—S. Alexander, 4210 Otter St., has awarded the contract for the construction of a 2 story, 48 x 132 ft. garage on 4th and Seigel Sts. Estimated cost, $55,000. Noted Aug. 11.

Pa., Philadelphia — The Columbia Steel Equipment Co., 3d and Ansbury Sts., will build a 1 story, 69 x 73 ft. factory for the manufacture of cabinets and office furniture. Estimated cost, $10,000. Clark & Dudnick, Drexel Bldg., Archt.

Pa., Philadelphia—L. M. Davis will soon award the contract for the construction of a 2 and 3 story, 60 x 60 ft. addition to his garage at 1616-18 Chancelor St. Estimated cost, $75,000. R. Priest, 1627 Sansom St., Engr. Noted Aug. 1.

Pa., Philadelphia—J. F. McCourt will soon award the contract for the construction of a 1 story, 40 x 156 ft. garage at 3672 Frankford Ave. Estimated cost, $50,000. F. P. Canavan, 7032 Greenway Ave., Archt.

Pa., Philadelphia—S. Ulick, 1904 North 32d St., will build a 4 story, 110 x 120 ft. garage on 33d St. and Columbia Ave. Estimated cost, $150,000. Clarke & Dudnick, Drexel Bldg., Archts.

MIDDLE WEST STATES

Ill., Chicago—A. V. Capraro, Archt., 105 North Clark St., is receiving bids for the construction of a 2 story, 75 x 120 ft. garage at 1918 South Morgan St., for Spingold & Son, 750 Taylor St. Estimated cost, $50,000.

Ill., Rock Island—J. M. Schaab, 1601 4th Ave., plans to build a 1 story, 62 x 150 ft. garage. Estimated cost, $50,000. Architect not selected.

Mich., Cadillac—R. T. Teetor, Muskegon, is having plans prepared for the construction of a 1 story foundry, here. Cost to exceed $50,000. F. D. Chase, 645 North Michigan Ave., Chicago, Archt.

Mich., Detroit—J. Doran, 270 East Milwaukee Ave., is having plans prepared for the construction of a 1 and 2 story, machine shop on Epworth Blvd. Estimated cost, $20,000. I. M. Lewis, 503 Congress Bldg., Archt.

O., Cleveland—Koller Bros., 724 Prospect Ave., have awarded the contract for the construction of a 1 story, 50 x 101 ft. garage at 663 Huron Rd. Estimated cost, $50,000.

Wis., Maribel—The Maribel Strawcutter Co., c/o H. Glover, has had plans prepared for the construction of a 1 and 2 story, 66 x 99 ft. factory on Main St. Estimated cost, $50,000. Private plans.

Wis., Milwaukee—Pauly & Marx, 2530 North Ave., will soon award the contract for the construction of a 1 story, 113 x 130 ft. garage on North Ave. Estimated cost, $60,000. J. Topzant, 307 Grand Ave., Archt.

Wis., Milwaukee—The Van Buren Garage Co., 174 Ogden Ave., will soon award the contract for the construction of a 2 story, 60 x 127 ft. garage on Van Buren St. Estimated cost, $75,000. R. E. Oberst, 307 Grand Ave., Archt. Noted Aug. 11.

IN AUGUST we published 147 leads of concerns in the market for machine tools and machinery—not counting the 171 items on new and enlarged shops. All this business-getting information was collected by our regular reportorial service. We can go on publishing a page of machine tool leads every week. We can make it several pages if you will cooperate.

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Business News Department

American Machinist
Tenth Avenue at 36th Street
New York

Wis., Osseo—C. J. Amundson plans to build a 2 story, 66 x 116 ft. garage and machine shop on Main St. Estimated cost, $50,000. Probably private plans.

Wis., Prairie du Sac — The Wisconsin River Power Co. has awarded the contract for the construction of a 1 story, 60 x 81 ft. power and machine shop on Main St. Estimated cost, $50,000.

WEST OF THE MISSISSIPPI

Mo., Kansas City—Unico Motor Products Co., c/o W. R. Alexander, 1229 West 59th St., has awarded the contract for the construction of a 1 story, 60 x 224 ft. factory on Rochester and Park Aves. Estimated cost, $75,000.

Mo., St. Louis — The Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh, Pa., has awarded the contract for the construction of a 2 story, 300 x 525 ft. manufacturing plant on Kingshighway and Slevin Ave., here. Estimated cost, $1,000,000. Noted June 9.

CANADA

Ont., Preston—The J. G. Brill Car Co., 62d St. and Woodland Ave., Philadelphia, has taken over the Preston Car & Coach Co., here, and will be known as the Canadian Brill Co., Ltd. The new company capitalized at $300,000 plans to install additional equipment.

General Manufacturing

NEW ENGLAND STATES

Mass., Taunton—Whittenton Mfg. Co., 30 Waverly St., manufacturer of dress goods, has awarded the contract for the construction of a 1 story, 80 x 80 ft. addition to its factory. Estimated cost, $30,000.

R. I., Pawtucket—T. Whalen, has awarded the contract for the construction of a 1 story bakery on Japonica St. Estimated cost, $30,000.

MIDDLE ATLANTIC STATES

N. J. Trenton—The Star Porcelain Co., Muirhead Ave., is receiving bids for the construction of a 1 story, 50 x 80 ft. porcelain plant. Estimated cost, $10,000. Private plans.

Pa., Philadelphia—The General Smelting Co., Stock Exch. Bldg., has awarded the contract for the construction of a 1 story, 66 x 100 ft. factory on Bath and Westmoreland Sts.

Pa., Philadelphia—C. Rost, 3814 Lancaster Ave., has awarded the contract for the construction of a 1 story, 20 x 40 ft. addition to his weaving mill at 3608 Lancaster Ave. Estimated cost, $5,000.

SOUTHERN STATES

Va., Roanoke—The Amer. Viscose Co., c/o C. A. Ernest, Marcus Hook, Pa., will build a 1 story mill here, for the manufacture of silk. Estimated cost, $1,000,000.

MIDDLE WEST STATES

Ill., Centralia—V. E. Joy plans to build a 2 story printing plant. Estimated cost, $60,000. Architect not selected.

Ill., East St. Louis—The Southern Illinois Milk Producers Assn., Arcade Bldg., is having plans prepared for the construction of a 1 story factory. Estimated cost, $50,000. R. G. Kirsch, Magnolia and Thurman Sts., St. Louis, Mo., Archts. Noted Sept. 8.

WEST OF THE MISSISSIPPI

S. D., Sioux Falls—The J. Morrell Co. has awarded the contract for the construction of a 3 story, 100 x 140 ft. addition to cooler building. Estimated cost, $150,000.

Tex., Dallas—The Peaslee Gaulbert Co., 413 West Main St., Louisville, Ky., has awarded the contract for the construction of a 1 story, 100x330 ft. factory and warehouse here. Estimated cost, $50,000.

WESTERN STATES

Cal., Los Angeles—Swift & Co., 922 East 1st St., is having plans prepared for the construction of a 1 story addition to packing plant, on East 1st St. Estimated cost, $60,000. J. E. Chatem, 922 East 1st St., Supt. Private plans.

Cal., Los Angeles—The Western Chemicals Co., 503 Merchants Bk. Bldg., is having plans prepared for the construction of a 1 story, 40 x 200 ft. chemical factory, with a 40 x 100 ft. wing, on San Pedro Annex. Estimated cost, $150,000. Private plans.

CANADA

Ont., Ottawa—The Ottawa Dairy Co., Sommerset St., has awarded the contract for the construction of a 2 story addition to dairy, on Cooper St. Estimated cost, $75,000.